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eastern Pacific Expeditions of the New York Zoological Society. XXXIX.
Mollusks from the West Coast of Mexico and Central America. Part VI.¹

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(Plates I & II).

[This is the thirty-ninth of a series of papers dealing with the collections of the Eastern Pacific Expeditions of the New York Zoological Society made under the direction of William Beebe. The present paper is concerned with specimens taken on the Templeton Crocker Expedition (1936) and the Eastern Pacific Zaca Expedition (1937-1938). For data on localities, dates, dredges, etc., refer to *Zoologica*, Vol. XXII, No. 2, pp. 33-46, and Vol. XXIII, No. 14, pp. 287-298.]

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INTRODUCTION.

This is the sixth of a series of papers dealing with collections of mollusks taken on the Templeton Crocker Expedition (1936) and the Eastern Pacific Zaca Expedition (1937-1938). The general plan of presentation followed in the present contribution is that mentioned in Part II of this series of papers². Formal headings and keys are given for the species collected by the expeditions of 1936 and 1937-1938. Occasionally additional species are included in the keys for convenience but in such cases it is indicated

² Hertlein, L. G., and Strong, A. M. Eastern Pacific Expeditions of the New York Zoological Society. XXXII. Mollusks from the West Coast of Mexico and Central America. Part II. *Zoologica*, New York Zool. Soc., Vol. 28, Pt. 3, December 6, 1943, pp. 149-168, pl. 1.

which species do not occur in the present collection.

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Superfamily Veneracea.

FAMILY VENERIDAE.

This large family is represented in the present collection by 51 species and subspecies which are assigned to 15 genera.

Four important papers published by Dall³, Jukes-Browne⁴, Palmer⁵ and Frizzell⁶ are especially useful to anyone studying the west American Veneridae. The paper by Frizzell contains much important information, including references to the supraspecific names applied to the Veneridae and a preliminary reclassification of this large group.

KEY TO THE GENERA OF THE VENERIDAE.

- A. Left valve with an anterior lateral tooth or denticle
 - a. Inner margin strongly crenulated
Antigona
 - aa. Inner margin not crenulated
 - b. Shell orbicular; large, polished
Dosinia
 - bb. Shell trigonal or elongated
 - c. Shell with reticulate sculpture; pallial sinus slight or lacking
Gouldia
 - cc. Shell with concentric sculpture only
 - d. Beaks subcentral; shell usually higher than long (sometimes anterior end longer); trigonal...*Tivela*⁷
 - dd. Beaks usually decidedly anterior; shell longer than high

³ Dall, W. H. Synopsis of the Family Veneridae and the North American Recent species. *Proc. U. S. Nat. Mus.*, Vol. 26, No. 1312, December, 1902, pp. 335-412, pls. 12-16.

⁴ Jukes-Browne, A. J. A Synopsis of the Family Veneridae. *Proc. Malacol. Soc. London*, Vol. 11, Pt. 1, March, 1914, pp. 58-74; Pt. 2, June, 1914, pp. 75-94.

⁵ Palmer, K. Van Winkle. The Veneridae of Eastern America, Cenozoic and Recent. *Palaeontogr. Americana*, Vol. 1, No. 5, pp. 209-522 (1-213), March, 1927, pls. 32-76 (1-45), February, 1929.

⁶ Frizzell, D. L. Preliminary Reclassification of Veneracean Eutelycops. *Bull. Mus. Roy. d'Hist. Nat. Belgique*, Tome 12, No. 34, December, 1936, pp. 1-84.

See also Tomlin, J. R. le B. Some synonyms in the Veneridae. *Proc. Malacol. Soc. London*, Vol. 15, Pt. 6, October, 1928, pp. 310-313.

⁷ The subgenus *Eutivela* Dall has crenulated inner margins but is not known to occur in west American waters.

- e. Ventral margin (internally) with oblique grooving; small
Transennella
- ee. Ventral margin without oblique grooving
- f. Pedal retractor impression deeply excavated; shell large, thick and smooth
Megapitaria
- ff. Pedal retractor impression not deeply excavated; shell smaller and thinner
- g. Anterior lateral small and situated near anterior margin of hinge plate (subgenus)
Agriopoma
- gg. Anterior lateral large and situated close to or nearly midway between anterior cardinal and anterior margin of hinge plate
*Pitar*⁸

- B. Left valve without an anterior lateral tooth
 - a. Inner margin crenulated
 - b. Shell elongate (anterior end often narrow) or subquadrate; small; concentric sculpture very prominent *Irus*⁹
 - bb. Shell roundly trigonal or ovately quadrate; usually large
 - c. Concentric sculpture of coarse, rugose ridges ... *Anomalocardia*
 - cc. Concentric sculpture of fine or coarse lamellae (sometimes much reduced)
 - d. Escutcheon well developed on left valve
 - e. Left posterior cardinal elongate; middle cardinal thick; hinge plate triangular; pallial sinus usually short *Chione*
 - ee. Left posterior cardinal short; middle cardinal not thickened (strongly bifid) hinge plate narrow and long; pallial sinus usually long
Protothaca s.s.¹⁰
 - dd. Escutcheon lacking or nearly so on left valve (subgenus) *Callithaca*

⁸ The subgenus *Tinctora* Jukes-Browne has an irregularly crenulated margin and is represented in west American waters by one species, *Pitar vulnerata*.

⁹ The type species of *Irus* has a smooth inner margin.

¹⁰ Not represented in the present collection.

- aa. Inner margin not crenulated
 - e. Shell suborbicular or roundly subquadrate
Cyclinella
 - ee. Shell obliquely elliptical or trigonal
 - f. Pallial sinus present
 - g. Obliquely elliptical; pallial sinus narrow
Compsomyax
 - gg. Trigonal; pallial sinus wide; small, length not exceeding 8 mm.
Psephidia
 - ff. Pallial sinus lacking (in type); anterior and middle cardinal teeth formed by a thin bent lamina, with two pits on ventral side
*Callocardia s.s.*¹⁰

Genus *Dosinia* Scopoli.

Key to the subgenera of *Dosinia*.

- A. Escutcheon present *Dosinia s.s.*¹¹
- B. Escutcheon lacking *Dosinidria*

Subgenus *Dosinidria* Dall.

Key to the species of *Dosinidria*.

- A. Orbicular, very large, usually longer than high; expanded posteriorly *ponderosa*
- B. Ovately or triangularly orbicular, smaller, usually as high or higher than long; not expanded posteriorly
 - a. Pallial sinus pointing toward middle of anterior adductor impression
dunkeri
 - aa. Pallial sinus pointing toward ventral margin of anterior adductor impression; ribs subobsolete medially
*annae*¹²

Dosinia (Dosinidria) dunkeri Philippi.

Cytherea dunkeri Philippi, Abbild. u. Beschreib. Conchyl., Bd. 1, Heft 7, October, 1844, *Cytherea*, p. 170 (4), pl. 2, fig. 5. "Patria: Mare Pacificum Mejico alluens."

Artemis simplex Hanley, Proc. Zool. Soc. London, April, 1845, p. 11. "Hab. Panama, St. Elena. Mus. Cuming, Hanley."—Hanley, Cat. Rec. Biv. Shells, Ap., p. 357, 1856, pl. 15, fig. 41, 1844. Panama.

Artemis dunkeri Reeve, Conch. Icon., Vol. 6, *Artemis*, 1850, species 34, pl. 6, fig. 34. "Hab. St. Elena and Panama, Central America (from sandy mud at low water); Cuming."—Adams & Reeve, Zool. Voy. Samarang, Moll., 1848, p. 78, pl. 21, fig. 17. Not the record "Hab. Eastern Seas."

Dosinia dunkeri Philippi, Carpenter, Cat. Mazatlan Shells, September, 1855, p. 61. Mazatlan, Mexico, also earlier records cited.

¹¹ Not represented in west American waters.

¹² Not represented in the present collection.

—Grant & Gale, Mem. San Diego Soc. Nat. Hist., Vol. 1, 1931, p. 354. Earlier records cited. Pliocene and Recent.

Type Locality: West coast of Mexico.

Range: Magdalena Bay, Lower California, to the Gulf of California and south to Zorritos, Peru, and the Galápagos Islands.

Collecting Stations: Mexico: Tenacatita Bay; Manzanillo (184-D-2), 30 fathoms, gravelly sand; 17 miles S.E. of Acapulco (189-D-3), 13 fathoms, mud; Port Guatulco; Nicaragua: Potosi and Monypenny Point, Gulf of Fonseca; Corinto (200-D-11, 19), 8-13 fathoms, sand, mangrove leaves, also beach drift, also Isla Encantada; Costa Rica: Port Parker; Culebra Bay; Isla Cedro, Gulf of Nicoya; 1 mile South of Golfito Bay; Panama: Isla Parida; Bahia Honda; Colombia: Gorgona Island.

Description: Shell white, somewhat ovately or triangularly orbicular, often slightly higher than long, beaks strongly projecting; lunule ovately oblong, moderately depressed; exterior regularly concentrically grooved, sometimes faint superficial radial striae are present; pallial sinus angular, usually projecting slightly beyond the middle of the shell and pointing toward the middle of the anterior adductor muscle impression.

A specimen from the Gulf of California in the Henry Hemphill collection in the California Academy of Sciences, measures: length, 56 mm.; height, 55 mm.; convexity (both valves), 30.6 mm.

The form described as *Dosinia annae* by Carpenter¹³ is very similar to *D. dunkeri* but the concentric ribs are flatter and more nearly obsolete in the middle portion of the valves and the pallial sinus points more nearly toward the base or ventral portion of the anterior adductor impression.

Compared to *Dosinia ponderosa*, *D. dunkeri* is smaller, higher in proportion to the length, less expanded posteriorly, umbos more ventricose, beaks more projecting, and it is sculptured by finer and more regular concentric grooves.

Dosinia brasiliensis White from the Miocene of Brazil is very similar to *D. dunkeri*, and *D. mathewsonii* Gabb from the Miocene of California also has some features in common.

Distribution: *Dosinia dunkeri* was collected at a number of localities from west Mexico to Colombia on beaches and dredged at depths of 8 to 30 fathoms. It is also known to occur from Pliocene to Recent in the Gulf of California region.

Dosinia (Dosinidria) ponderosa Gray.

Arthemis ponderosa Gray, Analyst, Vol. 8, 1838, p. 309. [No locality cited].

Artemis ponderosa Gray, Reeve, Conch. Icon., Vol. 6, *Artemis*, 1850, species 4, pl. 1, fig. 4. "Hab. Gulf of California (in sandy mud at low water)."

¹³ *Dosinia annae* Carpenter, Cat. Mazatlan Shells, September, 1855, p. 61. "Mazatlan; very rare."—Römer, Mon. Molluskengattung *Dosinia*, Scopoli, (Cassel), 1862, p. 18, pl. 4, fig. 1.

Dosinia ponderosa Gray, Grant & Gale, Mem. San Diego Soc. Nat. Hist., Vol. 1, 1931, p. 351, pl. 15, figs. 1a, 1b, 1c. Earlier records cited. Pleistocene and Recent.

Type Locality: Gulf of California (here designated as type locality). No locality cited originally.

Range: Scammon Lagoon, Lower California, to the Gulf of California and south to Paita, Peru, and the Galápagos Islands.

Collecting Stations: Mexico: Santa Inéz Bay, Gulf of California (144-D-1-4 and 145-D-1-3), 4-20 fathoms, sand, sandy mud, crushed shell, weed, calcareous algae, also on beach; Tenacatita Bay; Santa Cruz (195-D-21), 33 fathoms, mud; Nicaragua: Corinto (200-D-10,11,16), 4-8 fathoms, sand, mangrove leaves; Costa Rica: Port Parker (203-D-1,2,3), 18.2-27 fathoms, sandy mud, crushed shell, shelly mud, algae.

Description: Shell large, orbicular, longer than high, slightly angulated posterior to the ligament, gently convex, thick, cream colored and covered by a shining horn-colored periostracum; lunule cordate, depressed; exterior concentrically grooved but these are usually weaker in the median portion of the valves, faint superficial radial striae are sometimes present; pallial sinus angular and projecting to a point about midway between the anterior and posterior adductor impressions.

A large specimen from the Gulf of California, in the collections of the California Academy of Sciences, measures: length, 145 mm.; height, 139 mm.; convexity (both valves), 75 mm.

Compared to *Dosinia annae* Carpenter, the shell of the present species is larger, the posterior dorsal margin is more expanded, the beaks are less projecting, the posterior portion of the hinge plate is wider and the pallial sinus points toward about the middle rather than toward the base of the anterior adductor impression.

The shell of *D. ponderosa* is larger, thicker, more orbicular in outline, the beaks are less projecting, the dorsal outline is broader, the concentric sculpture is coarser, and the posterior portion of the hinge plate is wider than that of *D. dunkeri*. The Atlantic species *Dosinia concentrica* Born is somewhat similar, and related species occur in the Miocene and Pliocene of California, Peru, and the Caribbean region.

Distribution: Specimens of *Dosinia ponderosa* were collected from the Gulf of California to Costa Rica on beaches and dredged at depths of 4 to 33 fathoms. It also is known to occur in the Pleistocene of southern California, the Gulf of California region, Oaxaca, Mexico, and Ecuador.

Genus *Tivela* Link.

Key to the species of *Tivela*.

A. A broad, shallow, radial furrow present posteriorly; yellowish-white ... *argentina*
B. Radial furrow slight or lacking posteri-

orly; usually brown or brown with cream colored stripes, or purplish coloration

a. Very convex; high; thick ... *byronensis*

aa. Gently convex or compressed; longer than high (slightly produced anteriorly); thinner; dorsal margins meeting at a greater angle

b. Height usually exceeding 30 mm.; compressed, triangular, thin

c. Shell gaping posteriorly

hians¹⁴

cc. Shell closed posteriorly

planulata¹⁴

bb. Height usually not exceeding 30 mm.; more convex, thicker

delessertii

Tivela argentina Sowerby.

Cytherea argentina Sowerby, Proc. Zool. Soc. London, June 1, 1835, p. 46. "Hab. ad Sinum Nicoyo, Americae Centralis." "Found in sand banks at low water."—Sowerby, Thes. Conch., Vol. 2, 1851, p. 622, pl. 129, fig. 62 (as *Cytherea argentina*). Original locality cited.—Reeve, Conch. Icon., Vol. 14, *Cytherea*, 1864, species 11, pl. 4, fig. 11. Central America.

Type Locality: Gulf of Nicoya, Costa Rica, in sand banks at low water.

Range: Mazatlan, Mexico, to Panama.

Collecting Stations: Nicaragua: Corinto (200-D-10,11,19), 7-13 fathoms, sand, mangrove leaves, also in beach drift; Costa Rica: 1 mile south of entrance to Golfito Bay.

Description: Shell trigonal, rather thin, moderately convex, yellowish-white, ventral margin arcuate, somewhat attenuated at both ends; a broad, shallow, radial sulcus is present posteriorly; periostracum thin, light brown in color. A large valve from Costa Rica measures approximately: length 61 mm.; height 58 mm.; convexity 16.5 mm.

Distribution: *Tivela argentina* was collected by the expedition at Corinto, Nicaragua, where it occurs fairly commonly, and south of the entrance to Golfito Bay, Costa Rica. This species has been reported as occurring in the Pliocene of Argentina¹⁵ but according to von Ihering¹⁶ that record can be referred to *Tivela fulminata oblonga* Philippi.

Tivela byronensis Gray.

Cytherea radiata Sowerby, Proc. Zool. Soc. London, April 16, 1835, p. 23. "Hab. ad oras Columbiae Occidentalis. (Salango and Xipiapapi)." "Found in sandy mud at a depth of nine fathoms."—Sowerby, Thes. Conch., Vol. 2, 1851, p. 615, pl. 128, figs. 28, 29, 30, 31 (as *Cytherea radiata*). Original locality cited.

Not *Trigona radiata* Megerle von Mühl-

¹⁴ Not represented in the present collection.

¹⁵ *Tivela argentina* Sowerby, Borchert, Neues Jahrb. f. Miner. Geol. u. Palaeo., Beil. Bd. 14, 1901, p. 204, pl. 8, figs. 9, 10. "Paraná." Argentina, Pliocene.

¹⁶ von Ihering, H., An. Mus. Nac. de Buenos Aires, Vol. 14 (Ser. 3, Vol. 7), 1907, p. 384.

feld, 1811. [Referred to *Tivela mactroides* Born, 1778, by Dall, 1902].

Trigona byronensis Gray, Analyst, Vol. 8, 1838, p. 304. "Inhabits Pacific Ocean. Capt. Lord Byron."

Venus solangensis d'Orbigny, Voy. Amér. Mérid., Vol. 5, Moll., 1846, p. 564. New name for *Cytherea radiata* Sowerby, "(non *V. radiata*, Chemn., 1795; Risso, 1826)." Sowerby's locality for *C. radiata* cited.

Tivela radiata Sowerby, Römer, Monogr. Molluskengattung Venus, Linné, Bd. 1, 1865, p. 13, pl. 6, figs. 1a-g. Mazatlan, Salango, Xipixapi, Panama, Guayaquil.

Type Locality: Salango, Ecuador (here designated as type locality). "Pacific Ocean" originally cited.

Range: Lagoon Head, Lower California, to the Gulf of California and south to Guayaquil, Ecuador.

Collecting Stations: Mexico: Banderas Bay; Chamela Bay; Tenacatita Bay; Guatemala: 7 miles West of Champerico (197-D-1,2), 14 fathoms, mud; Nicaragua: Corinto (200-D-10, 11, 16, 19), 4-13 fathoms, sand, mangrove leaves, also Isla Cardon; Panama: Gulf of Chiriquí (221-D-1-5), 35-40 fathoms, sandy mud.

Description: Shell triangularly ovate, solid, gibbous, often somewhat produced posteriorly, lunule large; colored by reddish-brown radial and concentric bands; peristylum olive brown.

A specimen from Tiburon Island in the Gulf of California, in the collections of the California Academy of Sciences, measures: length, 58 mm.; height, 54.5 mm.; convexity (both valves together), 37 mm. Another from the same locality measures: length, 59.1 mm.; height, 50.4 mm.; convexity (both valves together), 39 mm.

This shell is very variable in shape and color. It may be nearly equilateral or quite inequilateral and ventricose or flattened and somewhat attenuated at each end. The color varies from the white variety, *semifulva* Menke, to all varieties of radially banded brown and white patterns to nearly all brown. Some of the specimens in the present collection could be referred to the striped and latticed color form *hindssii* Hanley¹⁷ but when a large series of specimens is examined so much variation in form and color can be observed that there seems to be but little use to apply names to the various color varieties. Carpenter came to the same conclusion after examining over 600 specimens of this species, as did Römer in his study of this species.

Tivela mactroides Born, in the Caribbean region, is a similar species.

Distribution: *Tivela byronensis* was collected at a few localities along the west coast from Mexico to Panama. It occurs commonly in tropical West American waters. It

also has been recorded as occurring in the Pleistocene of Lower California, and Oaxaca, Mexico, and in the Pliocene of Ecuador.

Tivela delesserti Deshayes in Sowerby.

Plate II, Figure 10.

Cytherea nitidula Lamarck, Sowerby, Thes. Conch., Vol. 2, 1851, p. 616, species No. 14, pl. 128, fig. 25. "Locality uncertain."

Cytherea delesserti Deshayes in Sowerby, Thes. Conch., Vol. 2, 1854, p. 785. "*C. nitidula* (14) is not the true species of Lamarck, but M. Deshayes has named it *C. Delesserti*."

Tivela delesserti Deshayes, Dall, Proc. U. S. Nat. Mus., Vol. 26, 1902, p. 386. "Scammon's Lagoon (young?); Cape St. Lucas, the Gulf region, and south to Acapulco."

Type Locality: Santa Inez Bay, east coast of Lower California (here designated as type locality). No locality cited originally.

Range: Santa Inez Bay, Gulf of California, to Oaxaca, Mexico.

Collecting Stations: Mexico: Santa Inez Bay, Gulf of California; Cape San Lucas.

Description: Shell broadly trigonal, slightly inequilateral, slightly attenuated anteriorly, moderately convex, a trace of a faint radial sulcus at about the posterior third of the valve present on most specimens; colored light chestnut brown with darker stripes or purplish-brown stripes on a cream colored ground.

A fine specimen from Santa Inez Bay measures: length, 30.9 mm.; height, 23.5 mm.; convexity (one valve), 8.8 mm.

The shell of *Tivela delesserti* is thicker and not as high as that of *T. planulata* Broderip & Sowerby. It is smaller, much more elongated, not as high in proportion to the length and flatter than *T. byronensis*, with striped varieties of which, at times, it has been confused.

Distribution: *Tivela delesserti* was collected by the expedition at Santa Inez Bay in the Gulf of California and at Cape San Lucas. It apparently does not occur nearly so commonly as *T. byronensis*.

Genus *Gouldia* C. B. Adams.

Gouldia C. B. Adams, Cat. Gen. and Spec. Rec. Shells in Coll. of C. B. Adams (Middlebury: Justus Cobb, printer), 1847, p. 29. Species cited, *G. cerina* Adams and *G. parva* Adams, both from Jamaica. Footnote states: "Syn. *Thetis*. Ad. This name having been preoccupied by Mr. Sowerby for two fossil species in the Green Sand formation of England, I propose the above in honor of my friend Dr. A. A. Gould."—K. V. W. Palmer, Palaeontogr. Amer., Vol. 1, No. 5, p. 307 (99), 1927. "Genoholotype.—*Gouldia cerina* (Adams)."

Not *Gouldia* Bonaparte, 1849. Aves.

Type: *Gouldia cerina* C. B. Adams. [Designated by Dall, Jour. Conch., Vol. 4, No. 2, April, 1883, p. 61. Referring to the two species originally cited by Adams, Dall stated,

¹⁷ *Cytherea hindssii* Hanley, Proc. Zool. Soc. London, December, 1844, p. 110. "Hab. Guayaquil. Mus. Cuming. Hanley."—Hanley, Cat. Rec. Bivalve Shells, Ap., p. 356. 1856, pl. 15, fig. 35, 1844. Guayaquil.—Reeve, Conch. Icon., Vol. 14, *Cytherea*, 1864, species 39, pl. 9, figs. 39a, 39b. Bay of Guayaquil, Ecuador.

... "I have taken the first, largest, and most conspicuous species of the two as a type." On page 62 he mentioned . . . "the typical *Gouldia cerina*." Illustrated by K. V. W. Palmer, text fig. 14, p. 307 (99), 1927, pl. 52 (21), figs. 1, 5, 9, 11, 21, 1929. North Carolina to the Antilles, Bermuda, and south to Cape San Roque, Brazil].

Shell small, beaks minute; lunule long, bounded by an impressed line; no escutcheon; pallial line simple or with a slight sinus; ornamented with fine concentric or reticulate sculpture (Palmer).

Palmer cited the occurrence of three species living in east American waters, six species and subspecies occurring in the Miocene, and two species in the Pliocene of eastern North and Central America.

So far as known this genus is represented by only one species in west American waters. It also is known to occur in the Pleistocene of the Gulf of California region.

Gouldia californica Dall.

Gouldia californica Dall, Proc. U. S. Nat. Mus., Vol. 51, No. 2166, January 15, 1917, p. 579. "Gulf of California near La Paz, in 21 fathoms."

Gafrarium (Gouldia) stephensae E. K. Jordan, Contrib. Dept. Geol. Stanford Univ., Vol. 1, No. 4, November 13, 1936, p. 136, pl. 19, figs. 10, 11. "Magdalena Bay, Lower California." "Pleistocene."

Type Locality: Gulf of California near La Paz, Lower California, Mexico, in 21 fathoms.

Range: La Paz, Lower California, Mexico, to Port Parker, Costa Rica.

Collecting Stations: Mexico: Manzanillo (184-D-2), 30 fathoms, gravelly sand; Costa Rica: Port Parker (203-D-1,3), 12-15 fathoms, sandy mud, crushed shell, shelly mud.

Description: Shell small, thin, white, with touches of brown along the dorsal border, ovate-triangular, the anterior lateral tooth large and prominent, the pallial line hardly sinuated; sculpture reticulate, the concentric sculpture more prominent in the middle of the disk, the radial toward the ends of the valves; the inner valve margins smooth. Length 6 mm.; height, 5.5 mm.; diameter, 3 mm. (Dall).

Distribution: This species was taken off Manzanillo, Mexico, in 30 fathoms and more abundantly at Port Parker, Costa Rica, in 12 to 15 fathoms. It also occurs in the Pleistocene of Magdalena Bay, Lower California.

Genus *Megapitaria* Grant & Gale.

Key to the species of *Megapitaria*.

- A. Margin below beaks broadly rounded; periostracum dull golden brown
aurantiaca
- B. Margin below beaks flattened; periostracum shiny purplish-brown, often mottled *squalida*

Megapitaria aurantiaca Sowerby.

Cytherea aurantiaca Sowerby, Gen. Rec.

and Foss. Shells, Vol. 2, Pt. 33, 1831, pl. 196, ng. 3. [No locality cited].

Cytherea aurantia Hanley, Sowerby, Thes. Conch., Vol. 2, *Cytherea*, 1851, p. 628, pl. 132, ng. 37 bis. "From Mr. Cuming's collection."

Dione aurantia Deshayes, Reeve, Conch. Icon., Vol. 14, *Dione*, 1863, species 12, pl. 3, ng. 12. "hab. Acapulco, South America".

Macrocallista aurantiaca Sowerby, E. K. Jordan, Contrib. Dept. Geol. Stanford Univ., Vol. 1, No. 4, 1936, p. 142. Magdalena Bay, Lower California, Pleistocene. Gulf of California to Ecuador, Recent.

Type Locality: Bay of Panama (here designated as type locality). No locality cited originally.

Range: Gulf of California to Salinas, Ecuador.

Collecting Stations: Mexico: Port Guatulco (195-D-4,6), 3-4.5 fathoms, sand, algae, crushed shell, also on shore; Tangola-Tangola Bay (196-D-14,15), 5 fathoms, crushed shell, also on shore; Costa Rica: Port Parker; Culebra Bay; Ballenas Bay; Golfito, Gulf of Dulce; Colombia: Gorgona Island.

Description: Shell large, ovate, convex, thick, smooth, the anterior end the shorter, indistinctly angled posteriorly; sculptured only with concentric lines of growth; periostracum dull orange brown beneath which the shell is orange pink or pinkish-brown; margin smooth.

Large specimens from the Gulf of California in the collections of the California Academy of Sciences measure 115 mm. in length.

The shell of this species is more broadly rounded in outline than that of *Megapitaria squalida*. The dull orange brown periostracum and orange pink shell is different from that of *M. squalida* in which the periostracum is a shiny purplish-brown, often mottled or striped, and the shell is a drab light brown.

Distribution: This species was collected on shore and dredged in 3 to 5 fathoms from west Mexico to Colombia. It also has been recorded as occurring in the Pliocene and Pleistocene of Lower California.

Megapitaria squalida Sowerby.

Cytherea squalida Sowerby, Proc. Zool. Soc. London, April 16, 1835, p. 23. "Hab. ad Sanctam Elenam." "Found in sandy mud at a depth of six fathoms."

Cytherea squalida Sowerby, Sowerby, Thes. Conch., Vol. 2, *Cytherea*, 1851, p. 629, pl. 131, figs. 87, 88, 89 [Lower] "California." [Not the record cited "from the Philippine Islands"].

Dione squalida Sowerby, Reeve, Conch. Icon., Vol. 14, *Dione*, 1863, species 10, pl. 3, fig. 10. Locality record same as cited by Sowerby, 1851.

Pitar (Megapitaria) squalidus Sowerby, Grant & Gale, Mem. San Diego Soc. Nat. Hist., Vol. 1, 1931, p. 347. Earlier records cited. Pliocene to Recent.

Type Locality: Santa Elena, Ecuador, in 6 fathoms, sandy mud.

Range: Scammon Lagoon, Lower California, to the Gulf of California and south to Mancora, Peru.

Collecting Stations: Mexico: East of Cedros Island (126-D-2), 38 fathoms, mud; Arena Bank (136-D-15, 16, 26, 30), 30-45 fathoms, mud, muddy sand, crushed shell, weed, rock; Cape San Lucas; Arena Point area; Ceraido Channel (131-D-3), 46 fathoms, rock; Ceraido Island, shore; Santa Inez Bay (141-D-1-4), 7-20 fathoms, sand, sandy mud, crushed shell, weed, calcareous algae, (143-D-1), 29 fathoms, mud, crushed shell, weed, (144-D-2), 2½ fathoms, sand, weed, rocks, (140-D-1, 3), 4-15 fathoms, sand, also at Santa Inez Point and at Monument Station, shore; Port Guatulco (195-D-1, 2, 21), 2.5-18 fathoms, sand, algae, crushed shell, mud; Tangola-Tangola Bay (196-D-17), 23 fathoms, mud; Costa Rica: Port Parker (203-D-1, 2, 3), 12-15 fathoms, sandy mud, crushed shell, shelly sand and mud, algae, also on beach; Port Culebra (206-D-1-3), 14 fathoms, sandy mud, also on shore; Cedro Island, Gulf of Nicoya; Golfito, Gulf of Dulce; Panama: Gulf of Chiriquí (221-D-1-5), 35-40 fathoms, sandy mud; Bahia Honda (222), shore; Colombia: Gorgona Island, shore.

Description: Shell large, attaining a length of 120 mm., smooth, convex, somewhat produced anteriorly and posteriorly and somewhat roundly angulated along the posterior umbonal slope; periostracum shiny purplish-brown often somewhat mottled or striped and beneath this the shell is colored a drab light brown.

The shell of this species differs from that of *Megapitaria aurantiaca* in the coloration and in that it is more produced both anteriorly and posteriorly. Although there appears to be nearly complete intergradation between the two, typical forms are quite distinct.

Macrocallista orcutti Dall, described from the Pleistocene of Magdalena Bay, is a similar species but possesses a much larger and thicker shell. *Macrocallista maculata* Linnaeus, which occurs in the Caribbean region, is another similar species.

Other names which have been applied to *M. squalida* include *Chione biradiata* Gray, 1838, and *Cytherea chionaea* Menke, 1847, which was proposed for a mottled, rounded form.

Distribution: *Megapitaria squadida* is very commonly found in the Gulf of California region and south to Peru. It was collected at many localities from off Cedros Island, Lower California, to Gorgona Island, Colombia, on the beach and dredged at depths of 2.5-46 fathoms. The largest number of specimens found at any one locality was at Port Parker, Costa Rica. It is also known to occur in the Pliocene and Pleistocene of the Gulf of California region and has been recorded¹⁸ as occurring in the Pleistocene of the Newport Bay area in southern California.

Genus *Transennella* Dall.

Key to the species of *Transennella*.

- A. Shell faintly concentrically grooved exteriorly
 - a. Length exceeding 10 mm.
 - b. Angle at beaks 90°; thick *pannosa*¹⁹
 - bb. Angle at beaks 120°; more produced anteriorly; moderately thin *puella*
 - aa. Length not exceeding 10 mm.
 - c. Angle at beaks 90° *tantilla*¹⁹
 - cc. Angle at beaks 110° *galapagana*¹⁹

- B. Shell strongly concentrically grooved exteriorly; lunule more broadly cordate *sororcula*

Transennella puella Carpenter.

Callista (?*pannosa*, var.) *puella* Carpenter, Ann. & Mag. Nat. Hist., Ser. 3, Vol. 13, April, 1864, p. 313. Described from "Cape St. Lucas." Reprint in Smithson. Miscell. Coll., No. 252, 1872, p. 211.

Transennella puella Carpenter, Hertlein & Strong, Proc. Calif. Acad. Sci., Ser. 4, Vol. 23, No. 24, 1939, pp. 377-378 (in text), pl. 32, figs. 14, 15, 16. Cape San Lucas on beach, also dredged.

Type Locality: Cape San Lucas, Lower California.

Range: Guadalupe Island, Lower California, to the Gulf of California and south to Nicaragua and probably to Panama.

Collecting Stations: Mexico: Cape San Lucas; Arena Bank in the Gulf of California (136-D-16), 45 fathoms, muddy sand, weed; Santa Inez Bay (145-D-1-3), 4-13 fathoms, sand; Port Guatulco (195-D-9), 7 fathoms gr. sand, crushed shell; Tangola-Tangola Bay (196-D-13), 10 fathoms, gr. sand, crushed shell.

Description: Shell roundly ovate, small, large specimens attain a length of about 18 mm.; hinge normal for the genus; color pattern consisting of various amounts of brown or brownish zigzag markings on a cream ground or whitish triangular areas surrounded by brown; pallial sinus only slightly ascending, rounded at end, projecting anteriorly to about one-half the length of the shell; interior whitish and purple; interior margin obliquely grooved; apical angle of beaks about 120°.

Transennella puella differs from *T. pannosa* Sowerby, which occurs off western South America, in the thinner shell, which is more produced anteriorly, and in that the apical angle is approximately 120° as compared to about 90° in Sowerby's species.

Macrocallista (*Chionella*) *omissa* Pilsbry & Lowe, 1932, described from San Juan del Sur, Nicaragua, was said to possess a shorter and more triangular shell than that of *Transennella puella* as well as different sculpture and color pattern.

¹⁸ See Bruff, S. C., Univ. Calif. Publ., Bull. Dept. Geol. Sci., Vol. 27, No. 6, 1946, p. 232.

¹⁹ Not represented in the present collection.

Distribution: Specimens of *Transennella puerula* were collected at several localities from Santa Inez Bay in the Gulf of California to Tangola-Tangola Bay, Mexico, on the beach and dredged in 4 to 45 fathoms.

***Transennella sororcula* Pilsbry & Lowe.**

Transennella sororcula Pilsbry & Lowe, Proc. Acad. Nat. Sci. Philadelphia, Vol. 84, May 21, 1932, p. 102, pl. 9, figs. 12-16, text, fig. 4. "San Juan del Sur, Nicaragua."

Macrocallista sororcula Pilsbry & Lowe, Proc. Acad. Nat. Sci. Philadelphia, Vol. 84, May 21, 1932, p. 143, pl. 9, figs. 12-16.

Transennella sororcula Pilsbry & Lowe, Hertlein & Strong, Proc. Calif. Acad. Sci., Ser. 4, Vol. 23, No. 24, 1939, p. 377 (in text), pl. 32, figs. 11, 12. Dredged in 20-220 fathoms due east of San Jose del Cabo, Lower California.

Type Locality: San Juan del Sur, Nicaragua.

Range: Santa Inez Bay, Gulf of California, to San Juan del Sur, Nicaragua.

Collecting Stations: Mexico: San Lucas Bay (135-D-25), 7 fathoms, sand; [?] (135-D-16), 6-20 fathoms, sand; Arena Bank (136-D-27), 50 fathoms, sand, calcareous algae, rock; Santa Inez Bay.

Description: Shell roundly ovate, varying in size from 16 to 35 mm. in length, glossy, rather deeply but unequally concentrically grooved, this character most strongly developed anteriorly and posteriorly; color cinnamon brown, or cream with radial markings or a network of chocolate-colored lines or various combinations of such patterns; interior white tinged with purple; the pallial sinus extends forward nearly one-half the length of the shell; inner margins obliquely grooved.

The more rounded outline, stronger concentric grooves, larger size and more broadly cordate lunule are characters which serve to separate *Transennella sororcula* from other species of the genus in west American waters.

Distribution: This species was taken by the expedition at a few localities from San Lucas Bay to Santa Inez Bay in the Gulf of California, on the beach and at depths of 6 to 50 fathoms.

Genus *Pitar* Römer.

Key to the subgenera of *Pitar*.

- A. Shell with spines or scales along posterior umbonal angulation *Hysteroconcha*
- B. Shell without spines or scales along posterior umbonal angulation
 - a. Shell with fine zigzag sculpture
Hyphantosoma
 - aa. Shell without zigzag sculpture
 - b. Shell suborbicular; inner margin irregularly crenulated *Tinctora*
 - bb. Shell ovate or subtrigonal; inner margin smooth
 - c. Shell smooth or with fine concentric threads

- d. Left middle cardinal decidedly longer and thicker than anterior cardinal
- e. Left anterior lateral very small and distant from cardinals

***Agriopoma*²⁰**

- ee. Left anterior lateral larger and close to cardinals *Pitarella*

- dd. Left middle cardinal only slightly longer than anterior cardinal *Pitar s.s.*

- cc. Shell with strong concentric ribs or lamellae. *Lamelliconcha*

Subgenus ***Pitar* s.s.**

Key to the species of *Pitar* s.s.

- A. Shell decidedly elongated; with brown zigzag concentric markings; smooth, very thin *newcombianus*
- B. Shell roundly trigonal or suborbicular
 - a. Anterior lateral tooth of left valve higher than others *consanguineus*
 - aa. Anterior lateral tooth of left valve not higher than others *unicolor*

***Pitar* (*Pitar*) *consanguineus* C. B. Adams.**

Cytherea consanguinea C. B. Adams, Ann. & Lyceum Nat. Hist. New York, Vol. 5, July, 1852, pp. 496, 545 (separate pp. 272, 321). "Panama."—Römer, Monogr. Molluskengattung Venus, Linné, (Cassel), Bd. 1, *Cytherea*, December, 1867, p. 108, pl. 28, figs. 5, 5a, 5b. Panama.

Cytherea consanguinea C. B. Adams, Sowerby, Thes. Conch., Vol. 2, 1853, p. 743, pl. 163, fig. 203. Panama.

Type Locality: Panama.

Range: Port Guatulco, Mexico, to Panama.

Collecting Stations: Mexico: Port Guatulco (195-D-1), 2.5 fathoms, sand, algae; Guatemala: 7 miles west of Champerico (197-D-2), 14 fathoms, mud; El Salvador: La Libertad (198-D-2), 14 fathoms, mud; Nicaragua: Monypenny Point, Gulf of Fonseca; Corinto (200-D-8, 9, 19), 6-24 fathoms, mangrove leaves, also on shore; Costa Rica: Port Parker (203-D-1, 2, 3), 10-15 fathoms, sandy mud, crushed shell, shelly sand, algae, shelly mud; Cedro Island, Gulf of Nicoya; Golfito, Gulf of Dulce.

Description: Shell roundly trigonal, beaks a little anterior to the center, smooth but with fine concentric lines of growth; ornamented with brown radial markings which often do not reach the ventral margin, in some specimens the beaks faintly pinkish colored; hinge with the anterior lateral of the left valve larger and higher than the others; interiorly the umbonal area is usually pink, the remainder of the shell white.

The largest specimen in the collection measures approximately: length 33 mm.; height, 26.4 mm.; convexity (one valve), 9.5 mm.

²⁰ *Agriopoma* has been placed in this key for convenience although it is also cited under *Callocardia*.

The shell of *Pitar consanguineus* is more rounded in outline and possesses a much larger anterior lateral tooth in the left valve in comparison to that of *P. mexicanus*.

The more rounded trigonal form and longer anterior dorsal margin serve to separate this species from *Pitar inconspicuus* Sowerby²¹ and *P. purus* Deshayes²², both described from Peru, and *P. tomeanus* Dall, described from Chile.

Distribution: Specimens referable to *Pitar consanguineus* were taken by the expedition from west Mexico to Costa Rica on the beach and dredged at depths of 2.5 to 24 fathoms. The largest number of specimens collected at any one locality, mostly small, was at Corinto, Nicaragua, in beach drift and dredged in 12-13 fathoms.

Pitar (Pitar) newcombianus Gabb.

C[irce]. L[ioconcha]. newcomiana Gabb, Proc. Calif. Acad. Nat. Sci., Vol. 3, January, 1865, p. 189. "Hab. two valves, Catalina Island, 120 fms. Dr. Cooper."

Pitaria newcomiana Gabb, I. S. Oldroyd, Stanford Univ. Publ. Univ. Ser. Geol. Sci., Vol. 1, 1924, p. 151, pl. 57, fig. 2. Monterey, California, to Lower California. Also Pleistocene and Pliocene.

Type Locality: Catalina Island, California, in 120 fathoms.

Range: Monterey, California, to the Gulf of California, and south to Port Guatulco, Mexico, and Clarion Island.

Collecting Stations: Mexico: Cape San Lucas; Port Guatulco (195-D-9), 7 fathoms, gr. sand, crushed shell.

Description: Shell thin, trigonally ventricose, polished, marked by minute concentric striae; beaks large, subcentral; anterior end prominent, narrowly rounded, posterior a little the widest, base convex; lunule not excavated, bounded by an impressed line; color yellowish-white, variously lined with brown angular lines; interior whitish; internal margin smooth; hinge teeth delicate (Gabb).

A specimen from Port Guatulco, Mexico, measures approximately: length, 17.3 mm.; altitude, 14 mm.; convexity (both valves together), 9 mm.

Distribution: One specimen of this species was taken at Cape San Lucas and one was dredged by the expedition at Port Guatulco, Mexico, in 7 fathoms. It also is known to occur in the Pliocene and Pleistocene of southern California and in the Pleistocene of Lower California.

²¹ *Cytherea inconspicua* Sowerby, Proc. Zool. Soc. London, June 1, 1835, p. 47. "Hab. ad Paytam, Peruviae." "Found in sandy mud at low water."—Sowerby, Thes. Conch., Vol. 2, 1851, p. 638, pl. 133, figs. 133, 134 (as *Cytherea inconspicua*). Payta, Peru.

²² *Dione pura* Deshayes, Cat. Conch. Biv. Shells in Brit. Mus., Pt. 1, 1853, p. 68. "Hab. Callao (Hinds')."

Cytherea pura Deshayes, Römer, Monogr. Molluskengattung Venus, Linné, (Cassel), Bd. 1, *Cytherea*, September, 1867, p. 84, pl. 23, figs. 1, 1a, 1b. Callao, Peru.

Cytherea (Caryatis) pudicissima E. A. Smith, described from the coast of India, was compared to *Dione pura* Deshayes (see Ann. & Mag. Nat. Hist., Ser. 6, Vol. 14, September, 1894, p. 169, pl. 5, figs. 3, 4. "Hab. off Ganjam, coast, 24 miles south-east of Gopalpur, in 89-93 fathoms").

Pitar (Pitar) unicolor Sowerby.

Cytherea unicolor Sowerby, Proc. Zool. Soc. London, April 16, 1835, p. 23. "Hab. ad Real Llejos Americae Centralis." "Found in coarse sand at a depth of six fathoms."—Sowerby, Thes. Conch., Vol. 2, 1851, p. 629, pl. 131, figs. 90, 91 (as *Cytherea unicolor*). "Xippixapi, West Columbia; coarse sand, at 6 fathoms. Cuming."

Chione badia Gray, Analyst, Vol. 8, 1838, p. 306. [No locality cited].

Cytherea ligula Anton, Verzeichniss der Conchyl., 1839, p. 7. [*Cytherea* cited as a subgenus of *Venus*.] [No locality cited.]—Philippi, Abbild. u. Beschreib. Conchyl., Bd. 1, Heft 6, *Cytherea*, July, 1844, p. 149 (1), pl. 1, fig. 2. "Patria . . ."

Dione unicolor Sowerby, Reeve, Conch. Icon., Vol. 14, *Dione*, 1863, species 33, pl. 8, figs. 33a, 33b. "Hab. West Columbia."

Type Locality: Real Llejos [near Corinto], Nicaragua, in 6 fathoms, coarse sand.

Range: Humboldt Bay, Lower California (Dall) [?Panama]. Acapulco, Mexico, to Jipijapa, Ecuador.

Collecting Stations: Costa Rica: Culebra Bay; Piedra Blanca Bay; Uvita Bay; Golfito; 1 mile south of the entrance to Golfito, Gulf of Dulce.

Description: Shell triangularly elongately rounded, somewhat compressed, thick, concentrically ridged but these are obsolete in the medial portion of the valves, fine radial striations are present on unworn specimens; color white or chestnut brown or some shade between the two. The pallial sinus extends forward more than half the length of the shell, the end is rounded.

The largest specimen collected measured approximately: length 46 mm.; height, 40.5 mm.; convexity (one valve) 10 mm.

Characteristic features of this species are the smooth medial areas externally and the long pallial sinus which extends forward more than half the length of the shell.

Distribution: This species was taken by the expedition only along the coast of Costa Rica.

Subgenus *Pitarella* Palmer.

Pitar (Pitarella) mexicanus Hertlein & Strong, sp. nov.

Plate I, Figures 3 and 8.

Pitar lenis Pilsbry & Lowe, Proc. Acad. Nat. Sci. Philadelphia, Vol. 84, May 21, 1932, p. 100, pl. 16, fig. 6. "Acapulco, 20 fathoms" (type). Also, "Guaymas, 20 fathoms" (paratypes).

Not *Cytherea lenis* Conrad, Jour. Acad. Nat. Sci. Philadelphia, Ser. 2, Vol. 1, 1848, p. 130, pl. 14, fig. 19. Marlbourne, Hanover County, Virginia, Eocene. Referred to "*Pitaria (Pitaria) lenis*" Conrad by Van Winkle Palmer, Palaeontogr. Amer., Vol. 1, No. 5, p. 218 (10), 1927, pl. 35 (4), fig. 7, 1929.

Type Locality: 4 miles south-southwest of Maldanado Point, Mexico, in 26 fathoms, mud.

Range: Santa Maria Bay, west coast of

Lower California, to Santa Inez Bay in the Gulf of California and south to the Gulf of Chiriqui, Panama.

Collecting Stations: Mexico: Arena Bank (136-D-2), 45 fathoms, mud, *Arca* conglomerate; Santa Inez Bay (143-D-4), 25 fathoms, sand, (146-D-1), 35 fathoms, mud, crushed shell; 19 miles west of Mazatlan (153); Manzanillo (184-D-2), 30 fathoms, gravelly sand; 4 miles ssw. of Maldanado Point (192-D-1), 26 fathoms, mud; Port Guatulco (195-D-1, 20), 2.5-23 fathoms, sand, algae, mud; Guatemala: 7 miles west of Champerico (197-D-1, 2), 14 fathoms, mud; El Salvador: Meanguera Island, Gulf of Fonseca (199-D-1), 16 fathoms, sand, mud, crushed shell; Nicaragua: (exact locality unknown); Costa Rica: Port Parker (203-D-1, 2, 3), 12-15 fathoms, sandy mud, crushed shell, shelly sand, algae, shelly mud; Port Culebra (206-D-1, 2, 3), 14 fathoms, sandy mud; Cedro Island, Gulf of Nicoya (213-D-1, 10), 8-10 fathoms, mud; off Ballenas Bay, Gulf of Nicoya (213-D-11, 17), 35 fathoms, mud.

Description: Shell elongately oval, rather thin, white, exteriorly resembling *Composomyax subdiaphana* Carpenter; ornamented with close, fine, concentric ripples over the whole valve or subobsolete medially; lunule large, cordate, bordered by an incised line; hinge of left valve with 3 cardinals and an anterior lateral tooth, the anterior and middle cardinals are joined dorsally, the middle one is longer and thicker, a pit occurs at the base, the posterior cardinal is elongate and thin, the lamella forming the middle and anterior cardinals bears slight irregularities or cusps, the anterior lateral with 2; hinge of right valve with a high thin anterior cardinal connected with a bifid posterior cardinal, the middle cardinal is separated from the anterior cardinal by a narrow space but separated from the posterior cardinal by a much wider space, anteriorly there are two low laterals separated by a pit; pallial sinus short, wide, ascending, rounded at the end. Dimensions: length, 42.3 mm.; height, 33.3 mm.; convexity (both valves together), 25 mm.; pallial sinus projects forward approximately 20 mm. from the posterior margin.

Holotype (Calif. Acad. Sci. Paleo. Type Coll.), from Station 192-D-1, Lat. 16° 16' 30" N., Long. 98° 37' W., 4 miles south-southwest of Maldanado Point, Mexico, in 26 fathoms (47 meters), mud.

The species described as *Cytherea lenis* by Conrad was referred to the genus "*Pitarria*" [=*Pitar*] by K. V. W. Palmer. This necessitates a new name for the west American species described under the name of *Pitar lenis* by Pilsbry & Lowe and the name *Pitar mexicanus*, based upon a specimen off Maldanado Point, Mexico, is here proposed.

The shell of this species is somewhat more elongated and less rounded and the left anterior lateral is less elevated than that of *P. consanguineus* C. B. Adams. It is variable in thickness and in the amount of rounding or subangulation of the posterior end.

The ornamentation of some large specimens is similar to that of *Pitar* (*Pitarella*) *gatunensis* Dall and *P. (P.) tumbezianus* Olsson, both of which are tropical American Miocene forms. The character of the hinge of the present species, which has the left middle cardinal more elongated and thicker than the anterior cardinal, together with the shape and ornamentation, are so characteristic of *Pitarella* that we have been led to place it in that subgenus.

Distribution: Specimens of this species were taken from Santa Inez Bay in the Gulf of California to the Gulf of Chiriqui, Panama. Usually only one or two specimens were found at each locality but about 75, many of them small, were dredged in 12 fathoms at Port Parker, Costa Rica. This species also has been recorded as occurring in the Pleistocene of Panama.

Subgenus *Hyphantosoma* Dall.

Key to the species of *Hyphantosoma*.

- A. Lunule broadly cordate; pallial sinus projecting forward considerably less than half the length of the shell; white ... *aletes*
- B. Lunule elongately cordate; pallial sinus projecting forward nearly half the length of the shell; brown markings ... *pollicaris*

Pitar (Hyphantosoma) aletes Hertlein & Strong, sp. nov.

Plate I, Figures 9, 11, 12 and 13.

Shell solid, roundly trigonal, plump, uniformly white; beaks prominent, anteriorly directed over a large cordate lunule defined by a fine impressed line; anterior dorsal margin short, straight, posterior dorsal margin sloping, arched, with a shallow depression on each side of the hinge line and extending to the posterior end; ends and ventral margin rounded; exterior surface ornamented by fine lines of growth, strongest near the margins, very faint near the beaks, crossed by numerous, almost microscopic, radial grooves which divercate along radial lines extending from the beaks to the posterior and anterior ends of the basal margin, obsolete near the beaks; hinge and ligament strong, normal for the genus and subgenus; pallial sinus short, fairly wide, rounded at the end, ascending, projecting forward to about one-third the length of the shell; interior white; margin smooth. The type measures: length, 53.8 mm.; height, 46 mm.; convexity (both valves together), 34.2 mm.; pallial sinus projects forward 21 mm. from the posterior margin.

Holotype (Calif. Acad. Sci. Paleo. Type Coll.), dredged at station 136-D-13, Lat. 23° 29' N., Long. 109° 24' W., Arena Bank, Gulf of California, in 45 fathoms (82 meters), mud, *Arca* conglomerate. Another single valve without information as to locality probably came from the same general region. A small right valve was dredged at Station 214-D-1-4, Lat. 9° 19' 32"—9° 17' 40" N., Long. 84° 29' 30"—84° 27' 30" W., 14 miles S. X E. of Judas Point, Costa Rica, in 42-61 fathoms, mud, shell, rocks.

A single left valve without information as to locality measures approximately: length, 46 mm.; height, 41 mm.; convexity (one valve), 16 mm. The specimen is slightly eroded but except for the absence of zigzag sculpture it is identical with *Pitar aletes*. Zigzag sculpture is lacking on small specimens and it seems likely that this type of sculpture may disappear with slight erosion of the larger shells or it may be missing on some specimens.

In general features the new species is somewhat similar to *Pitar pollicaris* but is higher in proportion to the length, more convex and trigonal in outline.

Pitar (Hyphantosoma) aletes bears a close resemblance to *Pitar (Hyphantosoma) carbaceus* Guppy,²³ described from the Miocene of Jamaica, but appears to be less broadly rounded posteriorly.

The species described by Dautzenberg as *Meretrix (Pitar) intricata*,²⁴ believed to occur in the East Indian region, resembles in general features the west American species here described. Dautzenberg's species differs in color and in other details. *Pitar (Hyphantosoma) sculpturatus* Marshall²⁵ from the Miocene of New Zealand is another member of this group.

Pitar (Hyphantosoma) pollicaris Carpenter.

Dione prora Conrad, Reeve, Conch. Icon., Vol. 14, *Dione*, October, 1863 species 45, pl. 10, fig. 45. "Cape St. Lucas, Xantus, California." [Specimen received by Reeve from Carpenter].

Callista pollicaris Carpenter, Ann. & Mag. Nat. Hist., Ser. 3, Vol. 13, April, 1864, p. 312. "Figured by Mr. Reeve (Conch. f. 45) as 'Dione prora, var'." Reprint in *Smithson. Miscell. Coll.*, No. 252, 1872, p. 210.—Verrill, Amer. Jour. Sci., Vol. 49, 1870, p. 219. Near La Paz, Lower California.

Pitaria pollicaris Carpenter, Proc. U. S. Nat. Mus., Vol. 26, 1902, p. 387. Gulf of California, Cape St. Lucas, and south to Callao, Peru.

Type Locality: Cape San Lucas, Lower California.

Range: Gulf of California to Callao, Peru.

Collecting Stations: Mexico: Port Guatulco (195-D-9), 7 fathoms, gr. sand, crushed shell; Colombia: Gorgona Island.

Description: Shell large, elongately oval, moderately inflated; anterior end somewhat projecting and roundly pointed, ventral margin rounded, posterior end somewhat roundly truncated; a shallow groove is present just

²³ See *Pitar (Hyphantosoma) carbaceus* Guppy, Woodring, Carnegie Inst. Washington, Publ. No. 366, May 20, 1925, p. 153, pl. 20, figs. 15-19. Bowden, Jamaica, upper Miocene.

²⁴ *Meretrix (Pitar) intricata* Dautzenberg, Journ. de Conchyl., Vol. 55, No. 4, March 30, 1908, p. 333, pl. 6, fig. 1. Exact locality unknown but believed to have come from the region of the Celebes.

²⁵ *Macrocallista sculpturata* Marshall, Trans. & Proc. New Zealand Inst., Vol. 50, July 15, 1918, p. 272, pl. 20, figs. 6, 6a. Fakaurangi Point, New Zealand. Mid-tertiary. See also *Pitar (Hyphantosoma) sculpturatus* Marshall, Laws, Trans. & Proc. Roy. Soc. New Zealand, Vol. 71, Pt. 2, September, 1941, p. 185.

ventral and roughly parallel to the posterior dorsal margin; lunule elongate and bounded by an impressed line, escutcheon narrow; perfect specimens are sculptured by fine zigzag grooves, young shells usually are sculptured in this manner especially on the anterior portions of the valves; the whole colored drab white but in young specimens often with brown zigzag markings which may be somewhat strengthened in radial bands; hinge normal, with a strongly developed anterior lateral tooth in the left valve; pallial sinus extends forward nearly to the middle of the shell, the end is broadly angulated; interior white; margin smooth.

A large specimen in the collections of the California Academy of Sciences from Carmen Island, Gulf of California, measures approximately: length 80 mm.; height, 60 mm.; convexity (both valves together), 39 mm.

The exterior of the shell of this species is often partially covered by a white powdery substance, apparently some form of algae.

This species bears a resemblance to *Pitar prorus* Conrad²⁶ from the western Pacific, but the anterior end is less acutely pointed, the posterior dorsal area bears a much stronger radial groove and the posterior margin is more truncated. No fine divaricate grooving is present on specimens of *Pitar prorus* collected by Ted Dranga at Vambia, Island of Ono, Fiji, which we have examined. Römer²⁷ discussed the relations of the west American and related species of this group in the Indo-Pacific region.

Distribution: Only a few specimens of *Pitar pollicaris* were collected by the expedition at Port Guatulco, Mexico, and at Gorgona Island, Colombia.

Subgenus *Hysteroconcha* Fischer.

Key to the species of *Hysteroconcha*.

- A. Posterior umbonal angulation bearing spines
 - a. Shell large; spines well spaced *lupanarius*
 - aa. Shell small; spines more numerous and crowded; concentric ridges thinly lamellate *multispinosus*²⁸
- B. Posterior umbonal angulation bearing scales *roseus*

Pitar (Hysteroconcha) lupanarius Lesson.

Cytherea lupanaria Lesson, Centurie Zool., 1830, p. 196, pl. 64 [four figs.]. "Cette belle espèce est très-commune sur les grèves entre Colan et Payta sur la côte du Pérou."—Lesson, Voy. Coquille, Zool., Vol. 2, Pt. 1, 1830, p. 430. Original locality cited.

Dione semilamellosa Gaudichaud, Reeve, Conch. Icon., Vol. 14, August, 1863, species 20, pl. 6, figs. 20a, 20b, 20c. "Hab. Central America."

²⁶ *Cytherea prora* Conrad, Proc. Acad. Nat. Sci. Philadelphia, Vol. 7, 1837, p. 253, pl. 19, fig. 18. "Inhabits the Pacific, probably towards the coast of New Holland."

²⁷ Römer, E., Monogr. Molluskengattung Venus, Linné, (Cassel), Bd. 1, *Cytherea*, 1867, p. 108.

²⁸ Not represented in the present collection.

Pitar (Hysteroconcha) lulanaria Lesson, Dall, Proc. U. S. Nat. Mus., Vol. 26, 1902, p. 388. Ballenas Bay, Lower California, to the Gulf of California and south to Payta, Peru.

Pitar (Hysteroconcha) lulanaria Lesson, R. H. Palmer & Hertlein, Bull. South. Calif. Acad. Sci., Vol. 35, Pt. 2, May-August (issued September 10), 1936, p. 73. Oaxaca, Mexico, Pleistocene.

Type Locality: Between Colan and Paita, Peru, on the strand.

Range: Ballenas Bay, west coast of Lower California, to the Gulf of California and south to Negritos, Peru.

Collecting Stations: Mexico: Chamela Bay; Tenacatita Bay; Sihuatanajo Bay; Tangola-Tangola Bay; Nicaragua: Potosi and Monypenny Point; Corinto (200-D-16, 19), 4-13 fathoms, mangrove leaves, also at Isla Cardon; Costa Rica: Golfito, Gulf of Dulce.

Description: Shell triangularly ovate, rather ventricose, concentrically ridged, these are somewhat laminated anteriorly and often somewhat obsolete posteriorly; one or two rows of long spines occur along the posterior dorsal umbonal angulation; color whitish and purple-violet, with violet spots at the base of the spines.

This species is very similar to *Pitar dione* Linnaeus which occurs in the Caribbean region. The shell of *Pitar lulanarius* is larger than that of the Antillean species and the ornamentation differs* in that violet spots occur at the base of the spines. *Dione expinata* Reeve, described from Central America, is a form of *P. lulanarius* in which the spines are greatly reduced in size.

A form bearing more numerous, more slender, crowded spines and thinner, more lamellate concentric ridges than typical *P. lulanarius*, was named "Cytherea multispinosa" by Sowerby. The shell described as *Callista (Dione) longispina* Mörch²⁹ appears to be somewhat similar to the form described by Sowerby.

Distribution: Specimens of this species were taken from Chamela Bay, Mexico, to the Gulf of Dulce, Costa Rica. It also has been recorded as occurring in the Pleistocene of Oaxaca, Mexico.

Pitar (Hysteroconcha) roseus Broderip & Sowerby.

Cytherea rosea Broderip & Sowerby, Zool. Jour., Vol. 4, No. 15, January, 1829, p. 364. "Hab. ad Littora Oceani Pacifici." "From St. Blas."—Sowerby, Zool. Beechey's Voy., 1839, p. 151, pl. 43, fig. 7. "Found abundantly at St. Blas."

Dione rosea Broderip & Sowerby, Reeve, Conch. Icon., Vol. 14, 1863, *Dione*, species 29, pl. 7, fig. 29. "Hab. Panama."

Pitaria (Hysteroconcha) rosea Broderip & Sowerby, Dall, Proc. U. S. Nat. Mus., Vol. 26, 1902, p. 389. Gulf of California to Panama.

Type Locality: San Blas, Mexico.

Range: Gulf of California to Panama.

Collecting Stations: Costa Rica: 1 mile south of the entrance to the Gulf of Dulce; Panama: Gulf of Chiriqui (221-D-1-5), 35-40 fathoms, sandy mud.

Description: Shell obliquely heart-shaped, compressed, rose-purple, obscurely banded, concentrically closely ridged, ridges here and there lamellated on the anterior side, on the posterior prickly lamellated along the margin, scarcely spined (Reeve).

Short scaly spines occur on the shell of this species in a white radial streak along the posterior umbonal angulation. A right valve collected in the Gulf of Dulce, Costa Rica, measures: length, 44 mm.; height, 34.4 mm.; convexity (one valve), 10 mm.

A subspecies, *Pitar roseus wiedenmayeri* H. K. Hodson, 1931, has been described from the Miocene of Venezuela. *Pitar vanwinkleae* Olsson, 1922, described from the Miocene of Costa Rica, is also said to be similar to *P. roseus*.

Distribution: One right valve of this species was collected by the expedition on the beach one mile south of the entrance to the Gulf of Dulce, Costa Rica, and one specimen was dredged in the Gulf of Chiriqui, Panama, in 35-40 fathoms. It also has been recorded as occurring in the Pliocene of Ecuador.

Subgenus *Lamelliconcha* Dall.

Key to the species of *Lamelliconcha*.

- A. Shell somewhat rostrate and pointed posteriorly *concinnus*
- B. Shell broadly rounded or subtruncated posteriorly
 - a. Concentric lamellae uniform in height *frizzelli*
 - aa. Concentric lamellae not uniform in height
 - b. Lamellae evenly spaced and alternating in height *alternatus*
 - bb. Primary lamellae separated by 1 to 3 lower lamellae *callicomatus*

Pitar (Lamelliconcha) circinatus alternatus Broderip.

Cytherea alternata Broderip, Proc. Zool. Soc. London, June 1, 1835, p. 45. "Hab. ad Columbiam Occidentalem. (Monte Christi)." "Dredged up in sandy mud at a depth of seven fathoms."

Dione alternata Broderip, Reeve, Conch. Icon., Vol. 14, *Dione*, 1863, species 28, pl. 7, figs. 28a, 28b. Broderip's types illustrated.

Cytherea circinata Born, Reeve, Conch. Icon., Vol. 14, *Dione*, August, 1863, species 25, pl. 7, figs. 25a, 25b. "Hab. Mazatlan."

Not *Venus circinata* Born, Test. Mus. Caes. Vindob., 1780, p. 61, pl. 4, fig. 8. "Patria ignota."

Type Locality: Monte Christi, Ecuador, in 7 fathoms, sandy mud.

Range: Gulf of California to Paita, Peru.

Collecting Stations: Mexico: Chamela Bay; Tenacatita Bay (183-D-2), 30 fathoms,

²⁹ *Callista (Dione) longispina* Mörch, Malakozool. Blätter, Bd. 7, January, 1861, p. 196. "Realejo specim. plura."

muddy sand; Tangola-Tangola Bay; Nicaragua: Corinto (200-D-11, 17, 19), 7-13 fathoms, sand, mangrove leaves; Costa Rica: UVita Bay; 1 mile south of Golfito Bay.

Description: The shell of this species is ornamented by sharp raised concentric ribs which, in perfect specimens, alternate in height. The color is white with radial chestnut rays and the lunule and escutcheon violet chestnut or in some specimens the entire shell may be entirely violet chestnut or white. The interior is white with violet chestnut on the dorsal portion.

A specimen collected by the senior author at Corinto, Nicaragua, measures: length, 137.5 mm.; height, 31 mm.; convexity (one valve), 11.6 mm.

Young specimens of this subspecies are remarkably similar to the east American *Pitar circinatus* Born. Large specimens are said to attain a greater size, greater convexity, and with the ribs somewhat more widely spaced than those on the east American form.

The shell of *Pitar circinatus alternatus* is more rounded in outline and lacks the decided posterior rostration of *P. concinnus* Sowerby.

Pitar (Lamelliconcha) petersoni Olsson, 1932, described from the Miocene of Peru, is a similar form.

Distribution: This subspecies was taken by the expedition on beaches and in shallow water from west Mexico to Costa Rica. It was found fairly abundantly at Corinto, Nicaragua.

Pitar (Lamelliconcha) callicomatus Dall.

Pitaria (Lamelliconcha) callicomata Dall, Proc. U. S. Nat. Mus., Vol. 26, No. 1312, December, 1902, pp. 389, 402, pl. 16, fig. 8. "Bay of Panama, in 14 fathoms, mud." Also in 7-30 fathoms.

Pitar callicomata Dall, Strong, Hanna & Hertlein, Proc. Calif. Acad. Sci., Ser. 4, Vol. 21, No. 10, 1933, p. 118. Acapulco, Mexico.

Type Locality: Bay of Panama, in 14 fathoms, mud.

Range: Acapulco, Mexico, to Panama.

Collecting Stations: Mexico: Port Guatulco (195-D-20), 23 fathoms, mud; Panama: Gulf of Chiriquí (221-D-1-5), 35-40 fathoms, sandy mud.

Description: Shape similar to but more oval than that of *Pitar circinatus alternatus*. It is ornamented by prominent concentric lamellae between which occur from one to three low secondary lamellae. The shell is of a dull white color.

The dimensions of the type specimen of this species, were given as: length, 47 mm.; height, 36 mm.; convexity, 22 mm.

Distribution: Only single valves of this species were taken at Port Guatulco, Mexico, in 23 fathoms, and in the Gulf of Chiriquí, Panama, in 35-40 fathoms.

Pitar (Lamelliconcha) concinnus Sowerby.

Cytherea concinna Sowerby, Proc. Zool. Soc. London, April 16, 1835, p. 23. "Hab. ad

Panamam." "Found at a depth of ten fathoms in fine sand."

Cytherea concinna Sowerby, Sowerby, Thes. Conch., Vol. 2, 1851, p. 630, pl. 132, figs. 99, 100. Original locality cited.

Dione concinna Sowerby, Reeve, Conch. Icon., Vol. 14, *Dione*, 1863 species 31, pl. 8, figs. 31a, 31b. "Hab. Panama, Mazatlan."

Cytherea affinis Broderip, Proc. Zool. Soc. London, June 1, 1835, p. 45. "Hab. ad Columbiam Occidentalem. (Xipixapi)." "Dredged up from sandy mud at a depth of ten fathoms."

Dione affinis Broderip, Reeve, Conch. Icon., Vol. 14, *Dione*, 1863, species 30, pl. 8, fig. 30. Original locality cited.

Cytherea tortuosa Broderip, Proc. Zool. Soc. London, June 1, 1835, p. 45. "Hab. ad Panamam, et ad Xipixapi." "Dredged up from sandy mud at a depth of six fathoms."

Dione tortuosa Broderip, Reeve, Conch. Icon., Vol. 14, *Dione*, 1863, species 61, pl. 12, fig. 61. Original locality cited.

Venus paytensis d'Orbigny, Voy. Amér. Mérid., Vol. 5, 1846, p. 565. "*Cytherea affinis*, Broder, 1835, Proceed. Zool. Soc., p. 45 (non *affinis*, Gmel., 1789, non *affinis*, Mathéron, 1842)."

Pitaria (Lamelliconcha) acuticostata Gabb, Li, Bull. Geol. Soc. China, Vol. 9, No. 3, October, 1930, p. 261, pl. 4, fig. 28. Dredged in Panama Bay. Referred to the Miocene. Li's record was referred to *Pitar (Lamelliconcha) concinna* Sowerby by Pilsbry (Proc. Acad. Nat. Sci. Philadelphia, Vol. 83, 1931, p. 430).

Not *Callista acuticostata* Gabb, 1873. [Now considered to be referable to the genus *Pitar*.]

Pitaria (Lamelliconcha) labreana Maury, Li, Bull. Geol. Soc. China, Vol. 9, No. 3, 1930, p. 261, pl. 4, fig. 29. Dredged in Panama Bay. Referred to the Miocene. Li's record was referred to *Pitar (Lamelliconcha) concinna* Sowerby by Pilsbry (Proc. Acad. Nat. Sci. Philadelphia, Vol. 83, 1931, p. 430).

Not *Pitaria (Lamelliconcha) labreana* Maury, 1912.

Type Locality: Panama, in 10 fathoms, fine sand.

Range: Magdalena Bay, Lower California, to the Gulf of California and south to Paita, Peru.

Collecting Stations: Mexico: Chamela Bay (182-D-1), 8 fathoms, sand, algae; Guatemala: 7 miles west of Champerico (197-D-1-2), 14 fathoms, mud; El Salvador: La Libertad (198-D-1-2), 13-14 fathoms, mud; Meanguera Island, Gulf of Fonseca (199-D-1), 16 fathoms, sand, mud, crushed shell; Nicaragua: Potosi and Monvpenny Point; Corinto (200-D-11, 17, 19), 7-13 fathoms, sand, mangrove leaves, also on shore and at Isla Cardon; Costa Rica: Golfito; Panama: Gulf of Chiriquí (221-D-1-5), 35-40 fathoms, sandy mud.

Description: Shell oblong, heart-shaped, rather compressed, chestnut-red or white, rayed with purple rows, concentrically

ridged, ridges slightly reflected, here and there wrinkled, posterior side a little flexuous (Reeve).

The shell of *Pitar concinnus* is somewhat rostrate posteriorly and by this character is readily separable from *P. circinatus alternatus*. It attains a length of at least 51.5 mm. On some specimens there is a shallow, radial depression just anterior to the posterior umbonal angulation.

Pilsbry & Lowe stated that "*Cytherea tortuosa*" Broderip is quite distinct from *P. concinnus*. The series of specimens of *P. concinnus* available to us leads us to agree with Dall's (1902) conclusion that *tortuosa* "is a white specimen with the ribs more irregular than usual."

Pitar (Lamelliconcha) salangus Pilsbry & Olsson, 1941, described from the Pliocene of Ecuador, is a very similar species. It is said to be constantly higher in proportion to the length and less produced posteriorly. *Pitar (Lamelliconcha) labreanus* Maury from the Pliocene of Trinidad is another similar species.

Distribution: This species was taken from west Mexico to Panama, on the shore and dredged at depths of 7 to 40 fathoms. It was dredged abundantly in the Gulf of Fonseca in 16 fathoms. It also has been cited as occurring in the Pleistocene of Maria Madre Island, Mexico, by Hertlein, in the Pliocene of Costa Rica by Olsson, and in the Pliocene of Ecuador as *Pitar (Lamelliconcha) affinis* by Pilsbry & Olsson.

Pitar (Lamelliconcha) frizzelli Hertlein & Strong, sp. nov.

Plate I, Figures 1, 5 and 7; Plate II, Figure 11.

Shell oblong, somewhat compressed, beaks low; surface sculptured by close, concentric ridges, the whole exterior colored by light brown with darker brown blotches and tent-shaped lines; anterior dorsal margin concave with an impressed, elongately cordate lunule; posterior dorsal margin sloping and slightly arched, ends and basal margin rounded; a faint shallow radial depression occurs just anterior to the posterior umbonal curve; hinge and ligament normal for the genus, hinge teeth rather delicate; pallial sinus fairly wide, ascending, rounded at the end, and projecting forward to nearly the center of the shell; interior yellow in the center shading to purple under the beaks and over the muscle scars, white toward the basal margin; margins smooth. The type measures: length, 46 mm.; height, 33.5 mm.; convexity (both valves together), 24 mm.; pallial sinus projects anteriorly 23.5 mm. from the posterior margin.

Holotype dredged at Station 136-D-22. Lat. 23° 28' 30" N., Long. 109° 25' W., Arena Bank, Gulf of California, in 45 fathoms (82 meters), mud. Five valves were dredged in the same general vicinity at Station 136-D-26. Lat. 23° 27' N., Long. 109° 24' W., in 45 fathoms, sand, crushed shell. Two valves

were dredged at Station 150-D-6, Lat. 23° 02' N., Long. 109° 31' W., Gorda Banks, in 60 fathoms, muddy sand, rocks, and two valves were dredged in the same general vicinity at Station 150-D-10, Lat. 23° 06' N., Long. 109° 25' W., in 50 fathoms, rock, crushed shell.

The concentric sculpture on this species is similar to that on *Pitar concinnus* Sowerby but the posterior end is much less pointed and the coloration is of an entirely different pattern.

This species is named for Dr. Don L. Frizzell in recognition of his contribution to the classification of the Veneridae.

Distribution: Specimens of this species were dredged only in the south end of the Gulf of California at depths of 40-60 fathoms.

Subgenus *Tinctora* Jukes-Browne.

Callizona Jukes-Browne, Proc. Malacol. Soc. London, Vol. 10, Pt. 6, September, 1913, p. 346. "Type, *Callista vulnerata*, Brod."

Not *Callizona* Doubleday, 1848. Lepid. Not *Callizona* Greef, 1875. Verm. (Polych.).

Tinctora Jukes-Browne, Proc. Malacol. Soc. London, Vol. 11, Pt. 1, March, 1914, p. 62. "Type, *Cytherea vulnerata*, Brod." New name for *Callizona* Jukes-Browne, 1913, not *Callizona* Doubleday, 1848.

Callizonata Strand, Arch. f. Naturgesch., Jahrg. 92, 1926, Abt. A, Heft 8, p. 40. New name for *Callizona* Jukes-Browne not *Callizona* Doubleday.

Type (by original designation): *Cytherea vulnerata* Broderip.

Shell thick, sub-orbicular, glossy; valve-margins crenulated; left posterior cardinal long and partly free from nymph; median very thick; pallial sinus short and rounded. Pedal scar as in *Callista* (Jukes-Browne, 1914).

Only one species of *Tinctora* is known.

Nanopitar Rehder³⁰ is said to be somewhat similar to *Tinctora* but lacks the irregular crenulations on the inner margin.

Pitar (Tinctoral) vulneratus Broderip.

Cytherea vulnerata Broderip, Proc. Zool. Soc. London, June 1, 1835, p. 46. "Hab. in Americâ Centrali. (Real Llejos)." "It was dredged up from sandy mud at a depth of six fathoms."—Sowerby, Thes. Conch., Vol. 2, 1851, p. 632, pl. 131, figs. 95, 96 (as *Cytherea vulnerata*). Original locality cited.

Dione vulnerata Broderip, Reeve, Conch. Icon., Vol. 14, *Dione*, 1863, species 16, pl. 5, figs. 16a, 16b. Original locality cited.

Pitaria vulnerata Broderip, Dall, Proc. U. S. Nat. Mus., Vol. 26, 1902, p. 388. Magdalena Bay, Lower California, to the Gulf of California and south to the Bay of Panama.

Type Locality: Real Llejos [near Corinto], Nicaragua, in 6 fathoms, sandy mud.

Range: Magdalena Bay, west coast of

³⁰ *Nanopitar* Rehder, Proc. U. S. Nat. Mus., Vol. 93, No. 3161, January 20, 1943, p. 188. "Genotype: *Pitar (Nanopitar) pilula*, new species," p. 188, pl. 19, figs. 5-10. Collected "in Lake Worth, Fla."

Lower California, to the Gulf of California and south to the Bay of Panama.

Collecting Stations: Mexico: Santa Inez Point, east coast of Lower California; Arena Point area, Lower California; Ceralbo Island, Gulf of California; Chamela Bay (182-D-1), 8 fathoms, sand, algae, also on beach; Tenacatita Bay.

Description: Shell suborbicular, moderately convex, finely concentrically ridged; cream color, the umbonal region often finely rayed or mottled with brown, irregularly spaced violet rings or zones of color usually occur more strongly developed toward the ventral margin; pallial sinus rather wide and projecting slightly upward and forward nearly half the length of the shell; inner margins irregularly crenulated. A fairly large specimen measures approximately: length, 45 mm.; height, 40 mm.; convexity (both valves), 27.5 mm.

Distribution: A few specimens of this species were taken by the expedition in the Gulf of California region. It has also been recorded as occurring in the Pleistocene of Oaxaca, Mexico.

Genus *Callocardia* A. Adams.

Key to the subgenera of *Callocardia*.

- A. Left anterior lateral very small and distant from cardinals (in type species); pallial sinus well developed.....*Agriopoma*
- B. Left anterior lateral and pallial sinus lacking (in type)*Callocardia* s.s.³¹

Subgenus *Agriopoma* Dall.

Callocardia (Agriopoma) catharia Dall.

Plate II, Figures 14 and 15.

Callocardia (Agriopoma) catharia Dall, Proc. U. S. Nat. Mus., Vol. 26, No. 1312, December, 1902, pp. 387, 402, pl. 14, fig. 3 (as *Callocardia catharia* on p. 402). "Bay of Panama in 30 fathoms, mud."

Type Locality: Panama Bay, in 30 fathoms, mud.

Range: Ballenas Bay, west coast of Lower California, to the Gulf of California and south to Panama, in 7 to 66 fathoms (Dall).

Collecting Station: Panama: Gulf of Chiriquí (221-D-1-5), 35-40 fathoms, sandy mud.

Description: Shell trigonally ovate, broadly rounded posteriorly, dull white, earthy, ornamented by fine concentric threads; lunule cordate, defined by an impressed line; pallial sinus wide, shallow, ascending.

One left valve 22.8 mm. long and 20.5 mm. high appears to be referable to the species described by Dall as *Callocardia catharia*. The hinge has a well developed anterior lateral tooth which is well separated from the anterior cardinal. The anterior and middle cardinal teeth are formed by a thin folded lamina (the middle tooth the longer) which at the apex of the fold bears two or three minute cusps; on the ventral side there are two triangular pits formed by shelly folds,

the anterior one deeper and lower and forming a depression in the hinge plate; the posterior cardinal is thin and separated from the middle cardinal by a flat-bottomed interspace, the posterior part of the hinge plate is roundly truncated; the pallial sinus is broad and shallow.

K. V. W. Palmer³² gave a discussion of the genus *Callocardia* and published illustrations of *C. guttata* A. Adams, the type of the genus, of which only a left valve is known. The anterior and middle cardinal teeth are formed of a folded lamina with 4 cusps and with a triangular pit on each side. Adams stated that it lacked a left anterior lateral and that the pallial line is simple. Later authors state that the pallial line on the type cannot be discerned clearly and that the degree of sinosity cannot be definitely stated. Palmer concluded from the curvature of the hinge of the type that a slight elevated area might occur in the region anterior to the cardinals. The general characters described for the shell are similar to those of the present species except that *C. catharia* has a well developed left anterior lateral and a short but well developed pallial sinus.

Dall placed *Callocardia catharia* in the subgenus *Agriopoma* Dall, the type of which is *Callocardia (Agriopoma) texaniana* Dall. As pointed out by Palmer, the characters of the hinge of that species are intermediate between *Callocardia* and *Pitar*. It has a very small left anterior lateral which is situated near the extreme anterior end of the hinge plate and there is a well developed pallial sinus. She considered both *Callocardia* and *Agriopoma* to be subgenera of *Pitar*. She also stated that several east American species originally assigned to *Callocardia* are now referable to other genera or subgenera.

No illustration of the hinge of the type specimen of *Callocardia catharia* has been published but Dall stated: "hinge well developed, normal." The present specimen shows many features said to characterize *Callocardia* as well as *Agriopoma* although it is not typical of the latter. We have therefore retained Dall's nomenclature for the present shell, at least until the characters of the type of *Callocardia* as well as those of the present species are better known.

Distribution: The specimen assigned to this species was taken by the expedition in the Gulf of Chiriquí, Panama, in 35-40 fathoms. According to Dall it occurs commonly as far north as Ballenas Bay, Lower California. A species with a somewhat similar shell which we have found occurring commonly in this same region is *Pitar (Pitarella) mexicanus* [= *P. lenis* Pilisbry & Lowe].

Genus *Antigona* Schumacher.

Key to the subgenera of *Antigona*.

- A. Pallial sinus moderately long, wide, and rounded at the end; escutcheon with a longitudinal furrow*Periglypta*

³² See discussion of *Callocardia* by Palmer, *Palaeontogr. Amer.*, Vol. 1, No. 5, pp. 246-248 (38-40), 1927, pl. 38 (7), figs. 1, 4, 11, 1929, and *Agriopoma*, pp. 241-242 (33-34), text fig. 3, 1927, pl. 38 (7), figs. 5, 12, 18, 14, 1929.

³¹ Not represented in the present collection.

B. Pallial sinus short and acutely angular; escutcheon without a longitudinal furrow
 a. Interspaces between major lamellae bearing concentric threads or lamellae
 Ventricola
 aa. Interspaces between major lamellae lacking concentric sculpture
 *Antigona s.s.*³³

Subgenus *Periglypta* Jukes-Browne.

Periglypta Jukes-Browne, *Proc. Malacol. Soc. London*, Vol. 11, Pt. 1, March, 1914, p. 72. "Type, *Venus puerpera*, Linn."

Type (by original designation): *Venus puerpera* Linnaeus.

Shell cancellated by strong concentric ridges crossed by radial ripples which crenulate the ridges. Escutcheon narrow, and the right half overlapping the left. Ligament deeply sunk. Nymphs usually having a fine rugose area. Anterior lateral very small and close to the anterior cardinal. Pallial sinus usually wide and rounded (Jukes-Browne).

The right posterior and middle cardinal teeth of each valve are cleft. A narrow longitudinal furrow occurs on the escutcheon.

Periglypta is known to occur from Miocene to Recent. It is represented in the lower Miocene of California by *Antigona vaquerensis* Loel & Corey, 1932.

Ameghinomya von Ihering,³⁴ founded on a fossil form from Argentina, appears to differ from *Periglypta* chiefly in lacking a longitudinal furrow along the escutcheon.

***Antigona (Periglypta) multicostata* Sowerby.**

Venus multicostata Sowerby, *Proc. Zool. Soc. London*, April 16, 1835, p. 22. "Hab. in Sinu Panamæ." "Found in coarse sand at low water."—Sowerby, *Thes. Conch.*, Vol. 2, *Venus*, 1853, p. 706, pl. 152, fig. 10. Original locality cited.—Reeve, *Conch. Icon.*, Vol. 14, *Venus*, 1863, species 9, pl. 3, fig. 9. Original locality cited.

Antigona multicostata Sowerby, Van Winkle Palmer, *Palaeontogr. Amer.*, Vol. 1, No. 5, p. 336 (128) (in text), 1927, pl. 61 (30), fig. 11, 1929. West coast of Panama.

Type Locality: Bay of Panama, at low water, sand.

Range: Gulf of California to Punta Verde, Peru, and the Galápagos Islands.

Collecting Stations: Mexico: Banderas Bay; Costa Rica: Port Parker; Culebra Bay; Colombia: Gorgona Island.

Description: Shell large, roundly quadrate, moderately inflated, very thick, anterior end rounded, posterior end roundly truncated; ornamented by thick concentric ribs reflected at the anterior end, undulated, in the middle crenulated, posteriorly irregular, alternately interrupted and slightly crenulated; evenly spaced low radial ribs cross both ribs and interspaces; lunule elongately cordate, pro-

³³ Not represented in the present collection.

³⁴ *Ameghinomya* von Ihering, *An. Mus. Nac. de Buenos Aires*, Vol. 14, (Ser. 3, Vol. 7), 1907, p. 71. "Je propose le nouveau sous-genre *Ameghinomya* pour ces espèces éteintes de *Chione* avec *Ch. argentina* Ih. comme type." Illustrated by von Ihering, *Rev. Mus. Paulista*, Vol. 2, 1897, p. 252, pl. 7, fig. 45. Upper Patagonian formation.

jecting medially; a longitudinal furrow occurs on the escutcheon; hinge with three stout cardinal teeth in each valve and a small denticle near the base of the anterior cardinal of the left valve, the middle cardinal of both valves and the posterior cardinal of the right valve cleft; pallial sinus short, rounded, slightly ascending, projecting anteriorly not quite a third of the distance between the two muscle impressions; inner margin very finely crenulated; interior white, often pinkish or violet under the hinge and umbonal region.

A large specimen collected at Port Parker, Costa Rica, measures approximately: length, 118 mm.; height, 115 mm.; convexity (both valves), 78 mm.; pallial sinus extends anteriorly 54 mm. from the posterior margin.

The shell of this species is quite similar to that of *Antigona listeri* Gray, an east American species. The west American shell is ornamented by coarser concentric lamellae and by more widely spaced radial sculpture.

Antigona dominica Palmer [= *Antigona caribbeana* Anderson], described from the Miocene of Santo Domingo, is a similar species.

Distribution: A few specimens of this species were collected by the expedition off west Mexico, Costa Rica, and Gorgona Island, Colombia. It also occurs in the Pliocene and Pleistocene of the Gulf of California region, and in the Pleistocene of Ecuador and the Galápagos Islands. Trechmann, 1933, cited a species under the name of "*Chione*" *multicostata* as occurring fossil on Barbados Island. We have not seen specimens from that region.

Subgenus *Ventricola* Römer.

Key to the species of *Ventricola*.

A. Shell suborbicular; large	<i>isocardia</i>
B. Shell more elongated; smaller; primary concentric lamellae finer and more closely spaced	<i>magdalena</i>

***Antigona (Ventricola) isocardia* Verrill.**

Plate II, Figures 2 and 3.

Venus isocardia Verrill, *Amer. Jour. Sci.*, Vol. 49, No. 146, March, 1870, p. 221. "Near La Paz,—Capt. J. Pedersen."

Cytherea (Ventricola) rigida Dillwyn, Dall, *Proc. U. S. Nat. Mus.*, Vol. 26, 1902, p. 390. Near La Paz, Lower California, in 9½ fathoms.

Not *Venus rigida* Dillwyn, *Descript. Cat.*, Vol. 1, 1817, p. 164. "Inhabits the coast of Jamaica. *Lister*. *Brazils*. *Solander*. West Indies. *Humphreys*."

Type Locality: Near La Paz, Lower California.

Range: Gulf of California, to Gorgona Island, Colombia.

Collecting Stations: Mexico: Arena Bank in the Gulf of California (136-D-2, 16, 26, 30), 35-40 fathoms, mud, *Arca* conglomerate, muddy sand, sand, weed, crushed shell; 3 miles off Pyramid Rock, Clarion Island (163-D-2), 55 fathoms, rock, coral; Costa Rica: Culebra Bay; 14 miles S. X E. of Judas Point

(214-D-1-4), 42-61 fathoms, mud, shell, rocks; Panama: Hannibal Bank (224), 35-40 fathoms, rock, mud, dead coral, sand, shells, algae; Colombia: Gorgona Island.

Description: Shell large, suborbicular, very convex, ornamented by strong concentric, slightly recurved lamellae which are crowded anteriorly and posteriorly, between these are several (about 6) crowded, slightly elevated lamellae, all lamellae faintly radially striated; lunule broad, cordate, impressed; a narrow smooth area present above and extending beyond the ligament on the left valve but not present on the right valve; right valve with 3 strong cardinal teeth, the middle one somewhat bifid, left valve with 3 cardinals and one short anterior lateral; pallial sinus short, pointed, extending toward the anterior adductor muscle impression a few millimeters beyond the anterior margin of the posterior impression; inner margin crenulated; colored exteriorly with brownish blotches arranged radially, interior white, pinkish or orange under the umbos. The largest specimen in the collection, from Costa Rica, measures approximately; length, 87 mm.; height, 81 mm.; convexity (one valve), 32 mm.; pallial sinus projects anteriorly about 30.5 mm. from the posterior margin.

The shell of this species is very similar to that of the Atlantic *Antigona rigida* Dillwyn and has at times been recorded from west American waters under that name. The posterior teeth of the west American shell are generally larger and longer and in the left valve the posterior tooth is separated from the ligament plate by a shallower groove than on the Atlantic shell. The hinge plate of *A. isocardia* is less flaring in front of the beak than that on the east coast species. *Antigona orientalis* Cox, described from the Pliocene of Mombasa, Africa, is said to be very similar to *A. rigida*.

Description: This interesting large bivalve was collected on beaches and was dredged at depths of 35-61 fathoms, in the southern end of the Gulf of California, off Clarion Island, off Costa Rica, and Gorgona Island, Colombia. It has been recorded as occurring in the Pleistocene of the Galápagos Islands.

Antigona (Ventricola) isocardia magdalena Dall.

Cytherea (Ventricola) magdalena Dall, Proc. U. S. Nat. Mus., Vol. 26, No. 1312, December, 1902, pp. 390, 403, pl. 15, fig. 6. Dredged "off Magdalena Bay on the west shore of Lower California, at station 2989, in 36 fathoms."

Type Locality: Off Magdalena Bay, Lower California, Mexico, in 36 fathoms.

Range: Magdalena Bay, Lower California, to Arena Bank, Gulf of California.

Collecting Station: Mexico: Arena Bank (136-D-2), 45 fathoms, mud, *Arca* conglomerate.

Description: Four single valves, about 35-40 mm. in length, in the collection dredged on Arena Bank in the Gulf of California, are

here referred to *Antigona isocardia magdalena*. These shells agree well with Dall's description and illustration of that form. The specimens appear to differ from young shells of *A. isocardia* Verrill in possessing a more elongated form and finer and more closely spaced concentric sculpture. The similarity to *A. isocardia* is so great that we consider *magdalena* to be a subspecies of Verrill's species. Dall stated that this form is similar to the east American *A. strigillina* Dall.

Distribution: The specimens here referred to *Antigona isocardia magdalena* were dredged on Arena Bank in the Gulf of California in 45 fathoms. Previously it has been recorded only from the type locality, off Magdalena Bay, Lower California.

Genus *Cyclinella* Dall.

Key to the species of *Cyclinella*.

- A. Shell inflated, lunule broadly cordate; sinus sharply angular at end and projecting nearly to center of shell *singleyi*³⁵
- B. Shell less inflated, lunule lanceolate
 - a. Shell subquadrate and elongated ventrally; compressed and rather thin; sinus often pointed at end *subquadra*
 - aa. Shell orbicular, dosinoid; moderately inflated and thick; sinus short, rounded at end and more anteriorly directed
 - b. Shell not exceeding 30 mm. in height *kröyeri*³⁵
 - bb. Shell exceeding 30 mm. in height *ulloana*

Cyclinella kröyeri ulloana Hertlein & Strong, subsp. nov.

Plate II, Figures 5, 6 and 7.

Shell orbicular, dosinoid, white, moderately inflated, moderately thick; sculptured by fine but well developed concentric lines of growth; pallial sinus fairly broad, short, rounded at the end, projecting about 33 mm. from posterior margin toward the anterior muscle impression; margin smooth. Dimensions: length, 75.5 mm.; height, 76.5 mm., convexity (one valve), 19 mm.

Holotype, left valve, from Station 143-D-4, Santa Inez Bay, Gulf of California, Lat. 26° 55' N., Long. 111° 54' W., dredged in 25 fathoms (46 meters), sand. Another large and two small valves were also found at this same locality. A few other valves, apparently referable to this subspecies, were taken at Station 136-D-2, Arena Bank, at the south end of the Gulf of California, in 45 fathoms, mud, *Arca* conglomerates.

Cyclinella kröyeri Philippi³⁶ was originally described from South America, and two localities, "Patria: Chile, Peru," were cited. The dimensions were given as "Long. 2"; alt. 11½"; crass. 6'." These measurements

³⁵ Not represented in the present collection.

³⁶ *Venus* (*Artemis*) *kröyeri* Philippi, Zeit. f. Malakozool., Jahrg. 4, June, 1847, p. 87. "Patria: Chile, Peru; legit cl. Kröyer."—Philippi, Abbild. u. Beschreib. Conchyl., Bd. 3, Heft 3, *Venus*, 1848, p. 78 (26), Taf. 7, fig. 9. Original locality cited.

in lines³⁷ would be equivalent, in the metric system, to length, 26.16 mm., height, 20.39 mm., convexity, 13.08 mm. The figures of the species given by Philippi in 1848 appear to represent nearly the natural size of the shell. Römer³⁸, 1862, stated regarding Philippi's species . . . "ist eine ächte *Cyclina*."

Dall³⁹, 1902, stated regarding this species: "It is smaller, more orbicular, and proportionately flatter than *C. subquadrata*." He also stated that *Artemis macilenta* Reeve⁴⁰, might be referable to Philippi's species. Reeve's illustration does not agree with the original illustration of *Cyclinella kröyeri* nor with our specimens but appears to resemble more nearly some forms of *C. subquadrata*. Sowerby⁴¹ suggested that it might be the young of *C. subquadrata*. In a later paper Dall⁴² gave the range of *C. kröyeri* as the Gulf of California to Valparaiso, Chile.

Specimens in the present collection vary in size from a small valve 23 mm. in length to a huge left valve 75.4 mm. in length. The huge size of these larger specimens, so far as we know, is much greater than that of any specimens which have been referred to *Cyclinella kröyeri*. The shells in the present collection were dredged only in the southern portion of the Gulf of California. We therefore have proposed the subspecific name *ulloana* for these large shells. This subspecies is named for Francisco de Ulloa, Spanish explorer, who in 1540 discovered that the Gulf of California was land-locked at the north end, thus revealing that Lower California was a peninsula, not an island as formerly believed.

The larger, more orbicular dosinoid form, more polished shell, broader, shorter, usually less pointed and more anteriorly directed pallial sinus, as well as the lack of elongation ventrally, are characters which serve to separate the present subspecies from *Cyclinella subquadrata* Hanley.

Cyclinella beteyensis Olsson⁴³, described from the Miocene of Costa Rica, was compared by its author to *C. kröyeri*.

Cyclinella subquadrata Hanley.

Artemis subquadrata Hanley, Proc. Zool. Soc. London, April, 1845, p. 11. "Hab. St. Elena, West Columbia. Mus. Cuming, Hanley." Ref. to "Ind. Test., sup. t. 15, f. 39."—Hanley, Cat. Rec. Bivalve Shells, p. 357, 1856?, pl. 15, fig. 39, 1844, "W. Columbia."—Reeve, Conch. Icon., Vol. 6, *Artemis*, Febru-

³⁷ For the metric equivalents of European "lines" see H. A. Rehder, *Mollusca* (Tavares, Florida), Vol. 1, No. 6, August 10, 1945, p. 73.

³⁸ Römer, E., Monogr. Molluskengattung Dosinia, Scopoli, (Cassel), 1862, p. 84.

³⁹ Dall, W. H., Proc. U. S. Nat. Mus., Vol. 26, 1902, p. 391.

⁴⁰ *Artemis macilenta* Reeve, Conch. Icon., Vol. 6, *Artemis*, March, 1850, species 51, pl. 9, fig. 51. "Hab. Salango, West Columbia, (in sandy mud at a depth of nine fathoms); Cuming."

⁴¹ Sowerby, G. B., Thes. Conch., Vol. 2, 1846, p. 662.

⁴² Dall, W. H., Proc. U. S. Nat. Mus., Vol. 37, 1909, p. 267.

⁴³ *Cyclinella beteyensis* Olsson, Bull. Amer. Paleo., Vol. 9, No. 39, January 21, 1922, p. 414 (242), pl. 34 (31), fig. 2. "Gatun Stage: Rio Betey." Costa Rica, Miocene.

ary, 1850, species 15, pl. 3, fig. 15. "Hab. St. Elena, West Columbia (in sandy mud at low water), and Lobos Island, Peru (in sandy mud at a depth of from six to seventeen fathoms); Cuming."

Arthemis saccata Gould, Proc. Boston Soc. Nat. Hist., Vol. 4, November, 1851, p. 91. "Inhabits Mazatlan?"—Gould, Boston Jour. Nat. Hist., Vol. 6, October, 1853, p. 396, pl. 15, fig. 2. "Inhabits Mazatlan."

⁴⁴ Type Locality: Santa Elena, Ecuador.

Range: Guaymas, Mexico, in the Gulf of California, to Paita, Peru, in 4 to 40 fathoms.

Collecting Stations: Mexico: Port Guatulco (195-D-19), 17 fathoms, gr. mud, crushed shell; Guatemala: 7 miles west of Champerico (197-D-2), 14 fathoms, mud; El Salvador: La Libertad (198-D-2), 14 fathoms, mud; Meanguera Island, Gulf of Fonseca (199-D-1), 16 fathoms, sand, mud, crushed shell; Costa Rica: Port Parker (203-D-1,2,3), 10-15 fathoms, sandy mud, crushed shell, shelly mud, algae; Port Culebra (206-D-1,2,3), 14 fathoms, mud; Cedro Island, Gulf of Nicoya (218-D-1-10), 4-10 fathoms, mud, sand, crushed shell; Gulf of Dulce; Panama: Gulf of Chiriquí (221-D-1-5), 35-40 fathoms, sandy mud; Bahia Honda (222).

Description: Suborbicular - subquadrate, broader than long, compressed, a little pellucid, very inequilateral, whitish both within and without, concentrically substriated; ventral edge arcuated in front; convex and rising behind; dorsal edge straightish and decidedly sloping in front, convex and not sloping behind; anterior end very broad, posterior end narrow; lunule large, nearly obsolete (Hanley, Cat. Rec. Biv. Shells, p. 357). The measurement was given as 1 3/4 [inches]. The pallial sinus is rather narrow, pointed, and directed toward the umbos, margin smooth.

The compressed, suborbicular-subquadrate and somewhat ventrally attenuated form of this species are characters which separate it from other west American species of the genus. *Cyclinella singleyi* Dall, 1902, which ranges from Scammon Lagoon, Lower California, to the Gulf of California and south to Panama, possesses a more tumid shell. *Cyclinella galera* Pilsbry and Olsson, 1941, described from the Pliocene of Ecuador, is similar to *C. singleyi* but the pallial sinus is said to differ in shape and direction. *Cyclinella kröyeri* Philippi is more orbicular and dosinoid in outline. We have not observed any specimens which could be referred to the species described as *Cyclina producta*⁴⁴ by Carpenter, which species was referred to the genus *Cyclinella* by Dall.

A subspecies, *Cyclinella subquadrata quitana* Olsson⁴⁵, has been described from the Miocene of Costa Rica and Trechmann⁴⁶ has

⁴⁴ *Cyclina producta* Carpenter, Proc. Zool. Soc. London, November 11, 1856, p. 161. "Hab In Sinu Panamensi; legit T. Bridges."

⁴⁵ *Cyclinella subquadrata quitana* Olsson, Bull. Amer. Paleo., Vol. 9, No. 39, June 21, 1922, p. 415 (243), pl. 34 (31), fig. 8. "Gatun Stage; Quitana Creek." Costa Rica.

⁴⁶ Trechmann, C. T., Geol. Mag., Vol. 70 (No. 823), 1933, p. 36, pl. 4, fig. 4.

cited a species as "Cyclinella near *C. subquadrata* Hanley" which occurs as a fossil on Barbados Island.

Distribution: Specimens of *Cyclinella subquadrata* were taken by the expedition from Port Guatulco, Mexico, to Bahia Honda, Panama, in 4 to 40 fathoms. This species has also been reported as occurring in the Pliocene of Ecuador and in the Quaternary of Peru.

Genus *Chione* Megerle von Mühlfeld.

Key to the subgenera of *Chione*.

- A. Concentric sculpture predominant
 - a. Concentric lamellae of broad thickened rolls sometimes coalescent medially
Lirophora
 - aa. Concentric lamellae thin, sharp, serrated
 - b. Pallial sinus well developed; one or more cardinal teeth in each valve bifid or strongly grooved
Chionopsis
 - bb. Pallial sinus very small; one or more teeth in each valve faintly grooved or all smooth ... *chione* s.s.
- B. Radial sculpture predominant (often coarse) anteriorly or over entire shell
 - a. Escutcheon present on left valve
 - b. Left anterior cardinal tooth elongated anteriorly and rather thin and high; radial ribs coarse anteriorly
Nioche
 - bb. Left anterior cardinal tooth short and thick; radial ribs coarse, flat-topped, over entire shell
Notochione
 - aa. Escutcheon lacking *Timoclea*⁴⁷

Subgenus *Chione* s.s.

Key to the species of *Chione* s.s.

- A. Concentric lamellae few and widely spaced; pallial line distant from margin
compta
- B. Concentric lamellae numerous, closer, often recurved
 - a. Shell rostrate or subrostrate posteriorly
 - b. Concentric lamellae strongly expanded posteriorly; interior rose and white *guatulcoensis*
 - bb. Concentric lamellae very low over entire shell; a radial shallow depressed area usually present anterior to dorsal margin
*crenifera*⁴⁸
 - aa. Shell usually rounded or subtruncated posteriorly; larger
 - c. Concentric lamellae on lower half of shell flattened forming a smooth surface
californiensis
 - cc. Concentric lamellae not flattened on lower half of shell, and

⁴⁷ Not represented in the present collection.

⁴⁸ Not represented in the present collection.

finer and more closely spaced
undatella

Chione (*Chione*) *californiensis* Broderip.

Venus succincta Valenciennes in Humboldt & Bonpland, Rec. d'Obser. sur Zool., 1827, p. 219, pl. 48, figs. 1a, 1b, 1c. "Habitat ad litus Oceani Pacifici, prope Acapulco Mexicanorum."

Not *Venus succincta* Linnaeus, Syst. Nat., ed. 12, Mantissa, 1771, p. 546. "Habitat . . ."

Venus californiensis Broderip, Proc. Zool. Soc. London, June 1, 1835, p. 43. "Hab. in sinu Californiae. (Guaymas.)." "Found in sandy mud at low water."—Reeve, Conch. Icon., Vol. 14, *Venus*, 1863, species 35, pl. 11, fig. 35. Original locality cited.

Chione succincta Valenciennes, Weymouth, State of Calif. Fish and Game Comm., Fish Bull. 4, 1920, p. 37, pl. 9, figs. 3, 4. Anaheim Slough, California. Also San Pedro, California, to Mexico.

Type Locality: Guaymas, Mexico, in the Gulf of California, at low water, sandy mud.

Range: Point Mugu, California, to Panama.

Collecting Stations: Mexico: East of Cedros Island (126-D-2), 38 fathoms, mud; Cape San Lucas; Monument Station, Santa Inez Bay, east coast of Lower California.

Description: Shell subcordiform, thick; ornamented by rather widely spaced (3 to 5 mm.), nearly equidistant, slightly reflexed concentric lamellae which at about the middle of the valve, and increasingly so toward the base, become crowded, flattened, thickened and nearly cover the interspaces; rounded radial ribs are present and increase by intercalation; lunule ornamented by incremental laminae and radiating ripples; 3 cardinal teeth in each valve, the right anterior and left posterior ones weaker than the others; pallial sinus very short and angular; margin crenulated.

Large specimens from the Gulf of California attain a length of approximately 68 mm., height, 65 mm., convexity (both valves), 38 mm.

As pointed out by Dall, this species can be separated from *C. undatella* Sowerby by the coarser and more widely spaced concentric sculpture, and by the fact that in adult forms the concentric lamellae on the ventral half of the disk are generally flattened and thickened, showing a smooth polished surface which nearly covers the interspaces.

A specimen 48 mm. in height may possess from 18 to 23 concentric lamellae while a large specimen 60 mm. in height may possess 30 to 40 such lamellae.

This species has also been recorded in the earlier literature under the names of *Venus leucodon* Sowerby, *Venus californiana* Conrad, and *Venus crassa* Sloat MS. in Carpenter.

Chione cancellata christopheri Trechmann, described from the Pliocene of St. Kitts Island in the Caribbean, is said to be a similar form.

Distribution: Specimens of this species were taken by the expedition at a few localities along western Mexico. It is often taken with *Chione undatella* Sowerby in bays and inlets just under the surface in firm sand or sandy mud. It also occurs in the Pleistocene of southern California and in the Pliocene and Pleistocene of the Gulf of California region.

***Chione (Chione) compta* Broderip.**

Venus compta Broderip, Proc. Zool. Soc. London, June 1, 1835, p. 43. "Hab. ad Peruviam. (Bay of Sechura.)" "It was dredged up in coarse sand and mud at a depth of seven fathoms."—Sowerby, Thes. Conch., Vol. 2, 1853, p. 710, pl. 154, figs. 32, 33, 34. Original locality cited.—Reeve, Conch. Icon., Vol. 14, *Venus*, 1863, species 48, pl. 13, fig. 48. Original locality cited.

Chione meridionalis I. S. Oldroyd, *Nutilus*, Vol. 34, No. 3, January, 1921, p. 93, pl. 4, figs. 3 and 4. "Type locality, Peru."

Not *Venus meridionalis* Sowerby, 1846. [Referred to the genus *Chione* by von Ihering, 1907].

Type Locality: Bay of Sechura, Peru, in 7 fathoms, sand and mud.

Range: Gulf of California to Bayovar, Peru.

Collecting Station: Costa Rica: Port Parker (203-D-1,2,3), 12-15 fathoms, sandy mud, crushed shell, shelly mud.

Description: Shell triangularly rounded, compressed, ornamented by widely spaced concentric ribs which posteriorly develop into broad, raised, gently reflexed lamellae; radial sculpture consists of well developed ribs and, in each interspace, a tiny riblet, anteriorly and posteriorly the ribs become fine and divaricate; pallial line unusually distant from the ventral margin; pallial sinus only slightly indented; margin crenulated.

The specimens of this species in the present collection are all small; the largest, a right valve, measures approximately: length, 33 mm.; height, 31 mm.; convexity (one valve), 10 mm.

The illustrations of *Chione compta* given by Sowerby do not reveal the most characteristic features shown on our specimens. However, the descriptions given by Broderip, Sowerby, and Dall, all exactly apply to our specimens. The species described by I. S. Oldroyd as *Chione meridionalis* appears to be identical with *C. compta*. Both were described from Peru and the characters described for the two are the same. The few, flattened and slightly up-turned concentric lamellae, flattened shell, fine divaricating ribs anteriorly and posteriorly, and pallial line distant from the margin, are all characteristic features of this species.

Distribution: Specimens of this species were dredged at Port Parker, Costa Rica, in 12-15 fathoms. It ranges south to Peru where it has also been recorded as occurring in the Pleistocene. It ranges north to the Gulf of California.

***Chione (Chione) guatulcoensis* Hertlein & Strong, sp. nov.**

Plate I, Figures 2, 4, 6 and 10;

Plate II, Figures 1, 8, 12 and 13.

Shell small, subrostrate, only moderately inflated; with low distant concentric lamellae which become expanded posteriorly; radial sculpture of low rather flattened ribs which are separated by subequal, smooth, narrower, interspaces, in the anterior medial area the ribs become obsolete toward the base especially on large specimens and anterior to this the ribs become faintly divaricate toward the base and a few interstitial threads appear; lunule elongated, ornamented by concentric and radial striations; escutcheon well developed, forming nearly a right angle with the dorsal margin, ornamented by fine concentric imbricating lamellae, the right valve slightly overlapping the left posteriorly; exterior white with brown or rose colored radial bands, or brown blotches and fine V-shaped brown lines and dots; interior white and rose, the latter predominant on large specimens; the right posterior and sometimes the left middle cardinal slightly grooved; pallial sinus shallow, broad, rather blunt, nearly vertical; inner margins crenulated except posteriorly. Dimensions (type): length, 11.2 mm.; height, 9.4 mm.; convexity (both valves together), 6 mm. The largest specimen, a paratype, measures 14 mm. in length.

Holotype and paratypes (Calif. Acad. Sci. Paleo. Type Coll.), dredged at Station 195-D-9, in Latitude 15° 44' 28" N., Longitude 96° 07' 51" W., off Port Guatulco, Mexico, in 7 fathoms (12.6 meters), in gr. sand and crushed shell.

This species is similar to *Chione mazyckii* Dall⁴⁹ described from North Carolina. It differs from the east American species in the narrower interspaces, the obsolete radial sculpture in the medial anterior ventral area and anterior to this the presence of only a few faintly divaricate ribs and interstitial threads. In *C. mazyckii* the anterior half of the ribs appear to divaricate and many interstitial threads make their appearance.

Chione crenifera Sowerby⁵⁰, described from Ecuador and Peru, has very low concentric lamellae over the entire shell and a radial, shallow, depressed area is present just anterior to the posterior dorsal margin.

***Chione (Chione) undatella* Sowerby.**

Venus undatella Sowerby, Proc. Zool. Soc. London, April 16, 1835, p. 22. "Hab. in Sinu Californiensi (Island of Tres Marias)."—Sowerby, Thes. Conch., Vol. 2, 1853, p. 711, pl. 153, fig. 22. Original locality cited.

Venus neglecta Sowerby, Zool. Beechey's

⁴⁹ *Chione mazyckii* Dall, Proc. U. S. Nat. Mus., Vol. 26, No. 1812, December, 1902, pp. 373, 382, pl. 13, fig. 2. Dredged "off Cape Fear, North Carolina, in 17 fathoms, sand."

⁵⁰ *Venus crenifera* Sowerby, Proc. Zool. Soc. London, June 1, 1835, p. 43. "Hab. ad Sanctam Elenam." Variety, "Hab. ad Paytam, Peruviae." "Found in the sand at low water."—Sowerby, Thes. Conch., Vol. 2, 1853, p. 718, pl. 156, figs. 73, 74. "... found in sand at low water at Payta, Peru."

Voy., 1839, p. 151, pl. 41, fig. 8. "Inhabits sandy mud on the coast of Central America."

Venus simillima Sowerby, Thes. Conch., Vol. 2, 1853, p. 708, pl. 153, figs. 17, 18. "California."—Reeve, Conch. Icon., Vol. 14, *Venus*, 1863, species 44, pl. 13, fig. 44. "Hab. San Diego, California."

Chione undatella Sowerby, Weymouth, State of Calif. Fish and Game Comm., *Fish Bull.* No. 4, 1920, p. 37, pl. 9, fig. 2. Anaheim Slough, California. Also San Pedro, California, to Mexico.

Type Locality: Tres Marias Islands, Mexico.

Range: Mugu Point, California, to Paita, Peru.

Collecting Stations: Mexico: Arena Bank (136-D-27), 50 fathoms, sand, calcareous algae, rock; Port Angeles, beach; Port Guatulco (195-D-1,2,5,10), 2-4 fathoms, sand, algae, crushed shell, also on beach; Tangola-Tangola Bay.

Description: Shell similar to that of *Chione californiensis* Broderip but slightly more inflated and ornamented with more numerous and more closely spaced thinner and sharper concentric lamellae. Often, but not always, the anterior cardinal tooth is more nearly parallel to the margin than that of *C. californiensis*. A specimen about 46 mm. in altitude may possess from 33 to 40 concentric lamellae.

This species has received many names in the literature, including *Venus bilineata* Reeve, *V. excavata* Carpenter, *V. entobapta* Jonas, *V. neglecta* Sowerby, *V. nuttalli* Conrad, *V. perdix* Valenciennes, *V. simillima* Sowerby and *V. sugillata* Reeve. Coarsely lamellose shells marked with brown and white are referable to the form named *Venus neglecta* Sowerby but there is so much variation in a series of specimens that we have followed Dall in referring them all to *C. undatella*.

Distribution: This species occurs commonly from southern California to Peru. It was taken by the expedition at a few localities off west Mexico. It also is known to occur in the Pleistocene of southern California, Lower California and the Galápagos Islands and in the Pliocene of the Gulf of California region.

Subgenus *Chionopsis* Olsson.

Chionopsis Olsson, *Bull. Amer. Paleo.*, Vol. 19, No. 68, June 30, 1932, p. 111. "Type.—*Chione amathusia* Philippi."

Type (by original designation): *Chione amathusia* Philippi.

Shell of moderate size to large; right posterior and middle left cardinal teeth bifid or grooved, sometimes the others; resilium very narrow with the ligament not deeply inserted and separated by a narrow, linear nymph; shell usually thinner than amongst the true Chiones; pallial sinus well developed; lunule equal or discrepant in size, its margin strongly crenate (Olsson).

Key to the species of *Chionopsis*.

- A. Coarsely serrated concentric lamellae
 - a. Concentric lamellae high; lunule elongately cordate. *gnidia*
 - aa. Concentric lamellae lower; lunule broadly cordate; finer radial ribbing; adductor impressions larger *amathusia*
- B. Concentric lamellae thin and very finely serrated
 - a. Posterior end obliquely truncated or rounded *purpurissata*
 - aa. Posterior end forming nearly a right angle or subrostrate *pulicaria*

Chione (Chionopsis) amathusia Philippi.

Venus amathusia Philippi, Abbild. u. Beschreib. Conchyl., Bd. 1, Heft 5, *Venus*, April, 1844, p. 129 (7), pl. 2, fig. 4. "Patria? . . ."

Type Locality: Panama Bay (here designated as type locality). No locality cited originally.

Range: Gulf of California to Mancora, Peru.

Collecting Stations: Mexico: 17 mi. SE. X E. of Acapulco (189-D-1,2,3), 18-20 fathoms, sandy mud, mud, algae; Guatemala: 7 miles west of Champerico (197-D-1,2), 14 fathoms, mud; El Salvador: La Libertad (198-D-1,2,), 13-14 fathoms, mud; Costa Rica: 14 miles S. X E. of Judas Point (214-D-1-4), 42-61 fathoms, mud, shell, rocks; Gulf of Dulce; Golfito, Gulf of Dulce; Panama: Gulf of Chiriquí (221-D-1-5), 35-40 fathoms, sandy mud.

Description: Shell triangularly ovate, rather inflated, posteriorly somewhat attenuated; ornamented by pairs of fine, radial ribs between which there is an interrib, and by concentric lamellae which are crenulated and give rise to prickly scales, the lamellae are radially marked on the ventral side; hinge with three cardinal teeth in each valve, the right posterior tooth and the left middle one cleft; pallial sinus well developed, short, rounded; margin crenulated.

The shell of this species is smaller than that of *Chione gnidia* Broderip & Sowerby. It often attains a length of about 40 mm. although it may reach a greater length. Compared to *Chione gnidia* the umbos of the present species are more highly rounded, giving a more cordate cross-section and more rounded lunule, the form is less elongate, the radial sculpture is finer and the concentric lamellae are lower. The adductor impressions of *C. amathusia* are a little larger than those on shells of *C. gnidia* of the same size.

Chione rowleei Olsson, described from the Miocene of Costa Rica, is a similar species.

Sowerby's figures of *Venus amathusia* (1853, pl. 154, figs. 26, 27) were referred by Römer to *Venus darwinii* Dunker⁵¹. Lamy⁵²

⁵¹ *Venus darwinii* Dunker in Römer, Krit. Untersuch. Moll. *Venus* (Cassel), 1857, p. 25 [No locality cited].—Römer, Malakozool. Blätter, Bd. 14, February, 1867, p. 51 (as *Chione darwinii*). "Panama, Mazatlan"—Pfeiffer, Conchyl.-Cab. von Martini-Chemnitz, Bd. 11, Abt. 1, Veneracea, 1869, p. 204, Taf. 33, figs. 3 and 4.

⁵² Lamy, E., *Journ. de Conchyl.*, Vol. 57, No. 3, 1909, pp. 243-244.

likewise referred Sowerby's figures as well as those of Reeve (1863, pl. XI, figs. 36a, 36b) to Dunker's species. Deshayes, 1853, considered Dunker's species to be a variety of *Chione amathusia* but Carpenter, 1857, regarded it as a variety of *C. gnidia*. Dall, 1902, regarded it "as a doubtfully distinct form and perhaps a variety of *C. subrostrata*." We have not seen specimens which we could refer with certainty to *Chione darwinii*.

Distribution: Specimens of this species were collected by the expedition from west Mexico to Costa Rica but nowhere abundantly. The largest number from any one locality was dredged in 14 fathoms west of Champerico, Guatemala. This species has been cited as occurring in the Quaternary of Manta, Ecuador, the Pliocene of Panama, and a similar or identical form in the Pliocene of Costa Rica.

***Chione (Chionopsis) gnidia* Broderip & Sowerby.**

Venus gnidia Broderip & Sowerby, *Zool. Jour.*, Vol. 4, No. 15, January, 1829, p. 364. "Hab. ad littora Oceani Pacifici." Dredged "near St. Blas."—Sowerby Genera Rec. and Foss. Shells, No. 41, 1834, pl. 251, fig. 7. [No locality cited].—Sowerby, Thes. Conch., Vol. 2, 1853, p. 709, pl. 154, fig. 25. Pacific Ocean.—Reeve, Conch. Icon., Vol. 14, *Venus*, 1863, species 37, plate 11, fig. 37. San Blas, Mexico.

Venus (Chione) gnidia Sowerby, Grant & Gale, *Mem. San Diego Soc. Nat. Hist.*, Vol. 1, 1931, p. 318, pl. 16, figs. 5a, 5b. Earlier records cited. Pleistocene and Recent.

Type Locality: San Blas, Mexico, dredged.

Range: Cedros Island, Lower California, to Paita, Peru.

Collecting Station: Mexico: Santa Inez Bay, east coast of Lower California.

Description: Shell roundly trigonal, convex, ornamented by prominent concentric lamellae which are rather coarsely scalloped and develop erect prickly scales, the under surface of the lamellae are radially sculptured; interspaces ornamented by well developed, nearly evenly spaced, obscurely paired ribs which are separated from the next pair by a smaller rib; hinge normal for the subgenus; pallial sinus well developed, short, the end rather rounded; exterior colored light drab brown or white, interior white; margin crenulated.

The shell of this species attains a large size. A large specimen collected at San Ignacio Lagoon, Lower California, by Henry Hemphill measures approximately: length, 101 mm.; height, 94.5 mm.; convexity (both valves), 68 mm.

This species attains a larger size, possesses a more elongated form, more prominent lamellation, more elongated lunule and coarser ribs than *C. amathusia*.

Venus ornatissima Broderip, 1835, is now considered referable to *C. gnidia*. *Chione jamaniana*, *C. manabia* and *C. trautoni*, described by Pilsbry & Olsson, 1941, from the Pliocene of Ecuador, are all quite similar to

C. gnidia. *Chione temblorensis* Anderson & Martin from the Miocene of California and *C. richthofeni* Hertlein & Jordan from the Miocene of Lower California are other species belonging to the *Chione gnidia* group.

Distribution: A couple of specimens of this species were collected by the expedition in Santa Inez Bay in the Gulf of California. It often occurs in the quiet waters of bays along the tropical west American coast. It also is known to occur in the Pleistocene of southern California, in the Gulf of California region, and has been cited as occurring in the Quaternary of Ecuador.

***Chione (Chionopsis) pulicaria* Broderip.**

Venus pulicaria Broderip, *Proc. Zool. Soc. London*, June 1, 1835, p. 44. "Hab. ad Columbianum Occidentalem. (Chiriqui and Tumaco)." "Dredged up from sandy mud at a depth of three fathoms."

Venus cingulata Lamarck, Sowerby, Thes. Conch., Vol. 2, 1853, p. 729, pl. 161, fig. 191. "West Columbia. Cuming."

Not *Venus cingulata* Lamarck, 1818.

Chione montezuma Pilsbry & Lowe, *Proc. Acad. Nat. Sci. Philadelphia*, Vol. 84, May 21, 1932, p. 101, pl. 15, figs. 12, 13, 14. "Costa Rica: Puntarenas."

Chione pulicaria Broderip, E. K. Jordan, *Contrib. Dept. Geol. Stanford Univ.*, Vol. 1, No. 4, 1936, p. 139. Magdalena Bay, Lower California, Pleistocene. Gulf of California to Colombia, Recent.

Type Locality: Chiriqui, Panama, in 3 fathoms, sandy mud (here designated as type locality). Tumaco, Colombia, also cited originally.

Range: Gulf of California, to Tumaco, Colombia.

Collecting Station: Nicaragua: Corinto (200-D-11-13, 17, 19), 3-10 fathoms, sand, mangrove leaves.

Description: Shell roundly triangular, in the adult somewhat acuminate at anterior and posterior ends, moderately convex, a broad shallow radial depression occurs parallel and anterior to the posterior dorsal margin; lunule cordate, brown, sculptured only by incremental lines of growth; escutcheon fairly large and elongate; concentric sculpture of numerous, rather fine, generally equally spaced, low, concentric lamellae, stronger and closer anteriorly and posteriorly and finely serrated by the radial sculpture which occurs on the ventral sides and in the interspaces; on large specimens the concentric sculpture is coalescent and subobsolete medially toward the ventral margin; colored exteriorly by white or cream ground mass with brown dots often arranged in a ^-shaped pattern; middle left and right posterior teeth bifid; pallial sinus well developed, ascending, rounded at end, directed toward the anterior adductor impression and attaining a height of about one half the height of the posterior adductor impression; color of interior white or cream and with purple often just below but sometimes also above the pallial line; margin crenulated.

Specimens of this species in the present collection are small, not over 22 mm. in length, but a large specimen from Kino Bay, Sonora, Mexico, collected by H. N. Lowe, measures: length, 47.3 mm.; height, 39 mm.; convexity (both valves), 30.5 mm.

Specimens of this species from various localities agree exactly with the description of the species given by Broderip, Sowerby, and Hanley, and with the illustration given by Sowerby. The illustration given by Reeve (*Venus*, pl. 8, fig. 26) does not show the acuminate form which develops with large shells, especially posteriorly.

We have been unable to detect any constant difference between this species and the shell described as *Chione montezuma* by Pilsbry & Lowe. There is variation in the amount of rostration and in the development of stronger and more obtuse lamellae posteriorly. After a consideration of these facts we have concluded that the species described by Pilsbry & Lowe belongs in the synonymy of *C. pulicaria*.

The ornamentation of *Chione oulotricha* Gardner, 1936, described from the Alum Bluff Miocene of Florida, appears to be similar to that of *C. pulicaria* but the posterior end of the Floridian fossil is obliquely truncated similar to that of *C. purpurissata*.

Distribution: Specimens of this species were taken only at Corinto, Nicaragua, in 3 to 10 fathoms. It occurs as far south as Colombia and is also known to occur in the Pleistocene of Magdalena Bay, Lower California.

Chione (Chionopsis) purpurissata Dall.

Venus crenulata var., Reeve, Conch. Icon., Vol. 14, *Venus*, June, 1863, species 46, pl. 13, fig. 46. "From the Gulf of California."

[*Venus crenulata*] "var. *lilacina*" Carpenter, Rept. Brit. Assoc. Adv. Sci. for 1863 (issued August, 1864), p. 570. Ref. to fig. 46 of Reeve. Reprint in *Smithson. Miscell. Coll.*, No. 252, 1872, p. 56. "Cape St. Lucas, Xantus."

Not *Chione lilacina* Gray, 1838.

Chione (Chione) purpurissata Dall, Proc. U. S. Nat. Mus., Vol. 26, No. 1312, December, 1902, p. 393. "Cape St. Lucas and the Gulf of California."

Type Locality: Cape San Lucas, Lower California, Mexico.

Range: Gulf of California to Guatemala.

Collecting Stations: Mexico: Santa Inez Point, east coast of Lower California; Chamela Bay (183-D-4), 16 fathoms, sand, algae, crushed shell.

Description: Shell roundly trigonal, rather tumid, posterior end rounded; ornamented by rather fine radial and concentric sculpture; lunule large, ornamented only by lines of growth; a shallow and rather narrow radial depression occurs posteriorly just above the escutcheon which is large and smooth; a strong raised ridge just above the ligament occurs on the left valve; mottled with brown externally, lunule brown; hinge normal for

the subgenus; pallial sinus ascending and projecting to a point about level with the middle of the posterior adductor impression; margin crenulated except posteriorly; interior colored rose purple.

A large specimen in the collection of the California Academy of Sciences, collected by Fred Baker at Carmen Island in the Gulf of California, measures approximately: length, 64.5 mm.; 57 mm.; convexity (both valves), 42.6 mm.

This shell is much like *Chione pubera* Valenciennes, an east American species, but is rounder in outline and it has less prominent lamellation.

Distribution: Only a couple of specimens of this species were collected by the expedition, one in the Gulf of California and one in Chamela Bay, Mexico. De Long⁵³ has cited this species as occurring in the Palos Verdes Sands, Pleistocene of Signal Hill, Long Beach, California, but we have not seen fossil specimens.

Subgenus *Lirophora* Conrad.

Key to the species of *Lirophora*.

- A. Concentric ribs of uniform strength across entire shell *mariae*
- B. Concentric ribs flattened and nearly coalescent medially
 - a. Ribs bifid on posterior dorsal slope; posterior end rather rostrate and pointed *obliterata*⁵⁴
 - aa. Ribs not bifid on posterior dorsal slope; ribs develop prominent lamellae along anterior and posterior ends; posterior end more broadly rounded *kelletii*

Chione (Lirophora) kelletii Hinds.

Venus kelletii Hinds, Zool. Voy. Sulphur, Vol. 2, Moll., Pt. 3, 1844 [January, 1845, on cover of Pt. 3], p. 65, pl. 19, fig. 5. "Inhab. Island of Quibo, West coast of Veragua. In adhesive mud of a low temperature, in between thirty and thirty-four fathoms."—Sowerby, Thes. Conch., Vol. 2, 1853, p. 721, pl. 155, fig. 64. Original locality cited.—Reeve, Conch. Icon., Vol. 14, *Venus*, 1863, species 82, pl. 18, fig. 82. "West coast of Veragua, Central America."

Chione (Lirophora) kelletti Hinds, Pilsbry & Olsson, Proc. Acad. Nat. Sci. Philadelphia, Vol. 93, 1941, p. 64, pl. 16, fig. 2. Canoa formation, Punta Blanca, Ecuador, Pliocene.

Type Locality: Island of Quibo [= Coiba], west coast of Veragua, Panama, in 30-34 fathoms, mud.

Range: Gulf of California to the Bay of Panama.

Collecting Stations: Mexico: Santa Inez Bay, east coast of Lower California (143-D-2,3,4), 25-30 fathoms, mud, crushed shell, sand; Tangola-Tangola Bay (196-D-19), 30 fathoms, mud; Costa Rica: 14 miles S. X E. of Judas Point (214-D-1-4), 42-61 fathoms,

⁵³ De Long, Jr., J. H., Trans. San Diego Soc. Nat. Hist., Vol. 9, No. 25, April 30, 1941, p. 248, and table opp. p. 244.

⁵⁴ Not represented in the present collection.

mud, rocks; Panama: Gulf of Chiriquí (221-D-1-5), 35-40 fathoms, sandy mud.

Description: Shell elongately oval, slightly produced at the ends; ornamented by yellowish-brown concentric ribs which are smooth and coalescent over most of the shell but develop into prominent white lamellae along the anterior and posterior ends; radially striated strongest on the upper portions of the umbos; pallial line very short, angular; margin finely crenulated.

A valve from Santa Inez Bay measures approximately: length, 65 mm.; height, 52.5 mm.; convexity (one valve), 18 mm.

Occasionally, small, thick shells of this species bear a slight resemblance to *Chione (Liophora) oblitterata* Dall⁵⁵ which was described from the Gulf of Panama. Dall's species, however, is narrower, more rostrate and more acutely pointed posteriorly, the lunule is shorter and the exterior of the shell is said to be "sculptured with heavy, tumid, concentric waves which in the adult become somewhat irregular and sometimes coalescent on the disk, more or less angular and bifid on the posterior dorsal slope." It is similar to *C. latilirata* Conrad which occurs in the Caribbean region.

Chione (Liophora) trimeris Gardner, from the Miocene of Florida, is somewhat similar to *C. kelletii*.

Distribution: Specimens of this species were taken from Santa Inez Bay in the Gulf of California to the Gulf of Chiriquí, Panama, at depths of 25-61 fathoms. It has been cited as occurring in the Pliocene and Pleistocene of Costa Rica and in the Pliocene of Panama.

E. K. Jordan⁵⁶ has cited *Chione kelletii* as occurring north to Todos Santos Bay, Lower California, but we have not seen specimens from the west side of the Peninsula.

Chione (Liophora) mariae d'Orbigny.

Venus cypria Sowerby, Proc. Zool. Soc. London, June 1, 1835, p. 43. "Hab. ad Insulam Platae, Columbiae Occidentalis." "Found among coral sand in seventeen fathoms."—Sowerby, Thes. Conch., Vol. 2, 1853, p. 722, pl. 157, fig. 113. Original locality cited.—Reeve, Conch. Icon., Vol. 14, *Venus*, 1863, species 116, pl. 23, figs. 116a, 116b. Original locality cited.

Not *Venus cypria* Brocchi, 1814; not *Venus cypria* Risso, 1826.

Venus mariae d'Orbigny, Voy. Amér. Mérid., Vol. 5, 1846, p. 563. "M. Cuming l'a pêchée à l'île de la Plata, sur les côtes de la république de l'Équateur." New name for *Venus cypria* Sowerby, not *V. cypria* Brocchi, 1814, not *V. cypria* Risso, 1826.

Type Locality: Island of Plata, Ecuador, in 17 fathoms, coral sand.

Range: Cedros Island, Lower California,

⁵⁵ *Chione (Liophora) oblitterata* Dall, Proc. U. S. Nat. Mus., Vol. 26, No. 1312, December, 1902, pp. 394, 405, pl. 16, fig. 2. "Humboldt Bay, Gulf of Panama."

⁵⁶ Jordan, E. K., Bull. South. Calif. Acad. Sci., Vol. 23, Pt. 5, September-October (issued October 25), 1924, p. 153.

to the Gulf of California and south to Guayaquil, Ecuador.

Collecting Stations: Mexico: East of Cedros Island (126-D-12), 45 fathoms, crushed shell, mud; Arena Bank (136-D-13, 14, 15, 18), 40-45 fathoms, mud, *Arca* conglomerates, crushed shell; Santa Inez Bay (142-D-3, 4; 143-D-3; 145-D-1, 3; 146-D-1; 147-D-2), 4-60 fathoms, sand, weed, mud, crushed shell; Costa Rica: Port Parker (203-D-1, 3), 12-15 fathoms, sandy mud, crushed shell, shelly mud.

Description: Shell roundly triangular, somewhat attenuated posteriorly, dorsal margins nearly straight, only slightly arched posteriorly, slightly concave anteriorly; lunule rather narrow; escutcheon narrow, long, flat, at right angles to the posterior umbonal area and ornamented by concentric lines of growth; sculptured with strong, high, recurved, concentric ribs which cross the shell and are radially striated on the ventral side and slightly flattened posteriorly, interspaces ornamented only with lines of growth; exteriorly light brownish or yellow with a few broad and many fine radial chestnut brown stripes; pallial sinus very short, narrow, subangulate; lunular and ventral margins finely crenulated.

A large valve collected in Santa Inez Bay, in the Gulf of California, measures approximately: length, 34 mm.; height, 26.3 mm.; convexity (one valve), 9 mm.

The shell of this species may be easily separated from that of *Chione kelletii* in that strong raised concentric lamellae cross the shell without any trace of coalescence or obsolescence medially.

Chione (Liophora) gorgona Pilsbry & Olsson,⁵⁷ described from the Pliocene of Ecuador, is very similar to large specimens of *C. mariae* and there are related forms in the Caribbean region.

Distribution: Specimens of *Chione mariae* were collected from the Gulf of California to Costa Rica. A few small specimens dredged off Cedros Island furnish an extension north of the known range of the species. It also is known to occur in the Pleistocene of the Gulf of California region and Panama, and in the Pliocene of Costa Rica and Ecuador.

Subgenus *Nioche* Hertlein & Strong, subgen. nov.

Type: *Venus asperrima* Sowerby. Illustrated by Sowerby in Thes. Conch., Vol. 2, 1853, p. 714, pl. 155, figs. 57, 58.

Description: Shell with well developed radial ribs but with reduced concentric sculpture, possessing a radially sculptured lunule which is delimited by an incised line and with a beveled escutcheon on the left valve; hinge similar to that of *Chione* s.s. but with the left anterior cardinal somewhat elongated, approaching parallelism with the dorsal margin and, in the type species, thin and very high, the right posterior and left central (and

⁵⁷ *Chione (Liophora) gorgona* Pilsbry & Olsson, Proc. Acad. Nat. Sci. Philadelphia, Vol. 93, September 9, 1941, p. 65, pl. 19, fig. 2. "Jama formation, Puerto Jama, Ecuador, Pliocene."

sometimes right central) cardinals bifid; inner margin crenulated; pallial sinus well developed.

This subgenus possesses characters apparently intermediate between *Chione* and *Protothaca*. It differs from the subgenus *Timothea* in possessing an escutcheon on the left valve and in that the left anterior cardinal is elongated and high. The well developed escutcheon on the left valve, finer radial sculpture, broader hinge plate and the position of the elongate thin high left anterior cardinal which is more nearly parallel to the dorsal margin are features which serve to separate *Nioche*⁵⁸ from *Protothaca*.

Key to the species of *Nioche*.

- A. Shell exceeding 10 mm. in length
 - a. Radial sculpture predominant (and rasp-like) over entire shell; rather compressed *asperrima*
 - aa. Radial sculpture predominant anteriorly and posteriorly; rather inflated *metodon*
- B. Shell not exceeding 10 mm. in length; ovately oblong *picta*

Chione (Nioche) asperrima Sowerby.

Venus asperrima Sowerby, Proc. Zool. Soc. London, June 1, 1835, p. 42. "Hab. ad Insulam Lobos dictam." "Found in fine sand at low water."—Sowerby, Thes. Conch., Vol. 2, 1853, p. 714, pl. 155, figs. 57, 58. Original locality cited.—Reeve, Conch. Icon., Vol. 14, *Venus*, 1863, species 19, pl. 6, figs. 19a, 19b. "Hab. Guacamayo, Central America (in sandy mud, at a depth of thirteen fathoms); Cuming."

Type Locality: Island of Lobos, Peru, at low water, in fine sand.

Range: Magdalena Bay, Lower California, to the Gulf of California and south to Paita, Peru.

Collecting Station: Costa Rica: Port Parker.

Description: Shell ovately oblong, rather compressed, sculptured with alternating large and small radial ribs which are crossed by fine close-set imbricating lamellae which give a rasp-like surface to the ribs; escutcheon on left valve smooth, beveled; the ribbing continues over the lunule which is elongated and delimited only by an incised line; exteriorly sometimes colored by radial violet-brown blotches; right middle and posterior teeth and left middle tooth often grooved, left anterior cardinal high; pallial sinus projecting toward middle of anterior adductor impression and reaching a point nearly midway between the two impressions, the end pointed; margin except posteriorly, crenulated.

A large valve collected at Port Parker, Costa Rica, measures approximately: length, 48.3 mm.; height, 39.8 mm.; convexity (one valve), 12.5 mm.

The rasp-like ornamentation of the ribs, larger lunule, well beveled escutcheon, broader hinge plate and high anterior cardinal on

the left valve are features which serve to separate shells of this species from those of *Protothaca grata* Say.

The species described as *Venus pectorina* by Lamarck, 1818, which occurs in the Caribbean region, is similar to *C. asperrima*.

Distribution: Three valves of this species, somewhat worn, were collected by the expedition on the beach at Port Parker, Costa Rica.

Chione (Nioche) metodon Pilsbry & Lowe.

Chione metodon Pilsbry & Lowe, Proc. Acad. Nat. Sci. Philadelphia, Vol. 84, May 21, 1932, p. 100, pl. 15, figs. 7, 8, 9, 10, 11. "Montijo Bay, Rep. Panama (Lowe)."

Type Locality: Montijo Bay, Panama.

Range: Banderas Bay, Mexico, to Montijo Bay, Panama.

Collecting Station: Mexico: Banderas Bay.

Description: Shell rotundly triangular, inflated, rather thin, colored buff with radially arranged violet-brown markings; lunule delimited by an incised line; sculpture of many low, rather evenly spaced concentric threads which are stronger and slightly lamelloose anteriorly and posteriorly; radial sculpture of many fine, low ribs which also occur on the lunule but not on the escutcheon and several coarser radial ribs occur anteriorly; the left anterior cardinal tooth is thin and high; pallial sinus short, but well developed, rounded or subangulate; interior margin finely crenulated; interior white with purple posteriorly.

The largest specimen collected, a right valve, measures approximately: length, 34 mm.; height, 31 mm.; convexity (one valve), 11 mm.; pallial sinus extends forward 14 mm. from the posterior margin.

This species bears some resemblance to specimens of *Chione purpurissata* Dall but is easily separated by the presence of 6 to 8 coarse grooves anteriorly, the radially sculptured lunule and the high left anterior cardinal.

Distribution: A few specimens of this species were collected by the expedition in Banderas Bay, Mexico. The record of the occurrence at this locality is an extension northward of the known range of the species.

Chione (Nioche) picta Dall in Willett.

Chione picta Dall in Willett, Bull. South. Calif. Acad. Sci., Vol. 43, Pt. 1, January-April (issued May 31), 1944, p. 21, pl. 8, figs. A, B. Type "collected by C. R. Orcutt in Magdalena Bay, Lower California, Mexico." Also cited from various localities in the Gulf of California region and in the Pleistocene in Los Angeles County, California.—Woodring, U. S. Geol. Surv., Prof. Paper 207, 1946, pp. 84, 88, pl. 37, figs. 3 and 4. San Pedro region, southern California, Pleistocene. Magdalena Bay, Lower California, to Panama, Recent.

Type Locality: Magdalena Bay, Lower California.

Range: Magdalena Bay, Lower California, to the head of the Gulf of California and south to Panama.

⁵⁸ *Nioche*, an anagram of *Chione*.

Collecting Stations: Mexico: Port Guatulco (195-D-8, 9), 6-7 fathoms, sand, gr. sand, algae, crushed shell.

Description: Shell small (not exceeding 10 mm. in length), ovately oblong, posterior dorsal margin long and nearly straight, an escutcheon present on left valve, the right valve overlaps the left along the posterior dorsal margin; sculptured with flattish radial ribs and concentric lamellae which become stronger and laminate on the posterior area; hinge with 3 teeth in each valve, the anterior cardinals slanting strongly forward, the right posterior and left middle cardinals grooved; pallial sinus short but well developed, blunt; inner margin of shell crenulated; exterior white with purple spots, occasionally purple spots over entire shell, interior white with purple beneath hinge and the posterior area.

A valve from Port Guatulco, Mexico, measures: length, 7.2 mm.; height, 5 mm.; convexity (one valve), 2 mm. The largest specimen in the collection measures 8.5 mm. in length.

Chione springvalensis Vokes⁵⁹ described from the upper Miocene of Trinidad, appears to be quite similar to *C. picta*.

Distribution: About 75 specimens of this species were dredged at Port Guatulco, Mexico, in 6-7 fathoms. It has been recorded as occurring north to the head of the Gulf of California and to Magdalena Bay on the west coast of Lower California. It has also been recorded as occurring in the Pleistocene of Los Angeles County, California, and it is known to occur in the Pleistocene at Magdalena Bay, Lower California.

Notochione Hertlein & Strong, subgen. nov.

Type: *Venus columbiensis* Sowerby. Illustrated by Reeve, Conch. Icon., Vol. 14, *Venus*, 1863, species 61, pl. 15, figs. 61a, 61b.

Shell ovately oblong, thick, moderately inflated, ornamented by fairly broad, heavy, flat-topped ribs which are separated by narrower grooves and crossed by rather fine closely spaced concentric lamellae, subobsolete on medial portions of valves; lunule cordate, delimited by an incised line and ornamented by concentric lines of growth and weak radial riblets; escutcheon beveled, smooth, well developed on the left valve, the corresponding portion of the right valve is rounded and posteriorly overlaps the left; colored by yellowish-gray and brown in general radial arrangement and mottled with larger blotches of ash-brown; hinge typical for the subgenus; pallial sinus well developed, narrow, slightly ascending, rounded or bluntly subangulate, projecting about a third the distance between the adductor impressions; margin crenulated, except posteriorly; interior white tinged with a streak of purple.

The moderate inflation, ovate, elongate shape and strong predominant radial ribbing is suggestive of *Protothaca*. It hardly seems referable to any supraspecific group with which we are familiar and we therefore propose a new subgenus *Notochione* with *Venus columbiensis* Sowerby as type.

Chione (Notochione) columbiensis Sowerby.

• *Venus columbiensis* Sowerby, Proc. Zool. Soc. London, April 16, 1835, p. 21. "Hab. ad Sanctam Elenam Columbiae Occidentalis." "Found in coarse sand at low water."—Sowerby, Thes. Conch., Vol. 2, 1853, p. 713, pl. 155, figs. 53, 54. Original locality cited.—Reeve, Conch. Icon., Vol. 14, *Venus*, 1863, species 61, pl. 15, figs. 61a, 61b. Original locality cited.

Type Locality: Santa Elena, Ecuador, at low water, in coarse sand.

Range: Mazatlan, Mexico, to Pacasmayo, Peru.

Collecting Stations: Mexico: Banderas Bay; Nicaragua: Potosi and Monypenny Point, Gulf of Fonseca; Fumarole, Gulf of Fonseca.

Description: Shell ovately oblong, thick; sculptured with rather broad, heavy, flat-topped radial ribs which are separated by narrower interspaces; ribs and interspaces crossed by fine, rather closely spaced concentric lamellae which are almost or wholly obsolete on the medial portions of the valves but are crowded anteriorly, giving a nodose appearance to the ribs; lunule cordate, rather small for the size of the shell, ornamented by concentric lines of growth and weak radial riblets; escutcheon beveled, smooth, well developed on the left valve, the corresponding portion of the right valve is rounded and posteriorly overlaps the left; colored by yellowish-gray and brown in general radial arrangement and mottled with larger blotches of ash-brown; hinge typical for the subgenus; pallial sinus well developed, narrow, slightly ascending, rounded or bluntly subangulate, projecting about a third the distance between the adductor impressions; margin crenulated, except posteriorly; interior white tinged with a streak of purple.

The largest specimen in the collection, from Potosi and Monypenny Point, Nicaragua, measures approximately: length, 52 mm.; height, 48 mm.; convexity (both valves), 31.5 mm.

The shell from Japan described as *Venus hirasei* by Pilsbry⁶⁰ was compared to *Chione columbiensis* and appears to be another member of the same group.

Distribution: A few specimens of this species were taken in Banderas Bay, Mexico, and off Nicaragua, in the Gulf of Fonseca. It has been cited occurring as a fossil in Peru.

⁵⁹ *Chione (Chione) springvalensis* Vokes, Amer. Mus. Novit., No. 988, May 16, 1938, p. 14, fig. 6 (on p. 13). Springvale, Trinidad, Upper Miocene.

⁶⁰ *Venus hirasei* Pilsbry, Proc. Acad. Nat. Sci. Philadelphia, Vol. 53, May 2, 1901, p. 205. "Hirado, Hizen." Japan. Also p. 400, pl. 19, fig. 1, pl. 20, fig. 20, August 16, 1901.

Protothaca jedoensis hirasei Pilsbry, Hirase, Coll. Jap. Shells, (Matsumura Sanshodo: Tokyo, Japan), 1934, p. 22, pl. 41, fig. 3.

Genus *Anomalocardia* Schumacher.

Anomalocardia Schumacher, Essai nouv. Syst. Vers Test., 1817, pp. 44, 134, pl. 20, fig. 4. Sole Species, "Venus flexuosa Lin. Chemn. 6. pag. 332. Tab. 31. fig. 335."—Prashad, Siboga Exped., Monogr. 53c, 1932, Lamell. p. 260. Genotype: *Anomalocardia fluctuosa* Linnaeus.

Type (by virtual monotypy): *Venus flexuosa* Linnaeus. Illustrated by Chemnitz, Neues Syst. Conchyl.-Cab., Bd. 6, 1782, p. 332, pl. 31, fig. 335. "Es wohnt diese seltene Muschel in den ostindischen Meeren."

Anomalocardia appears to be closely related to *Chione*. The teeth are not bifid and diverge widely from a common center. The shells are usually rather thick and somewhat rostrate posteriorly. The sculpture consists of concentric ridges and subdued radial ribs. The lunule and escutcheon are impressed. The inner margins are crenulated and the pallial sinus is small, often angular and sometimes almost obsolete.

The three west American species in the present collection assigned to *Anomalocardia* differ somewhat in details of shape and sculpture as compared to the type of the genus, *A. flexuosa* Linnaeus. However, there are also similarities and we have therefore followed Dall and Jukes-Browne⁶¹ in placing these species under *Anomalocardia*.

This genus occurs from Pliocene to Recent in Lower California and from Miocene to Recent in Peru and in the Caribbean region. It also occurs both fossil and Recent in the East Indies.

Key to the species of *Anomalocardia*.

- A. Shell with radial furrow anterior to posterior dorsal fold
 - a. Concentric sculpture usually strong over entire shell; posterior dorsal fold strong from beak to base *subrugosa*
 - aa. Concentric sculpture well developed near the beak and anterior submargins only; posterior dorsal fold well developed near beak only *broggi*⁶²
- B. Shell without radial furrow anterior to posterior margin; with bifurcate radial ribs
 - a. Shell with 20-25 concentric ridges *subimbricata*
 - aa. Shell with 6-8 concentric step-like ridges; tumid *tumens*

Anomalocardia subimbricata Sowerby.

Venus subimbricata Sowerby, Proc. Zool. Soc. London, April 16, 1835, p. 21. "Hab. ad Portam Portreram Americae Centralis." "Found in fine sand in thirteen fathoms." Variety from "Acapulco"—Sowerby, Thes. Conch., Vol. 2, 1853, p. 711, pl. 154, figs. 35-38. Puerto Portrero, Central America. Fig. 38 from [Lower] "California."—Reeve, Conch. Icon., Vol. 14, *Venus*, 1863, species 85,

pl. 19, figs. 85a, 85b, 85c. Original locality cited.

Type Locality: Puerto Portrero, Costa Rica, in 13 fathoms, sand.

Range: La Paz, Lower California, to Paita, Peru.

Collecting Stations: Mexico: Banderas Bay; Chamela Bay; Passavera Island; Chamela Bay; Tenacatita Bay; Port Guatulco (195-D-2, 6, 7, 11, 14, 15), 1.5-5 fathoms, sand, algae, crushed shell, gr. sand, coral; Santa Cruz Bay; Tangola-Tangola Bay; Costa Rica: Port Parker; Port Culebra; Culebra Bay; Panama: Isla Parida, Gulf of Chiriqui, Panama.

Description: Shell subtrigonal, ornamented by strong concentric ridges which in large specimens may number about 20-25; radial ribs are present, these are single in the early stages of growth but soon bifurcate due to deepening of a shallow medial incised line, a low radial riblet occurs in the major interspaces; lunule cordate, bordered by an incised line, lunule and escutcheon ornamented only by lines of growth; exteriorly colored by brown radial bands and sometimes by small irregular, V-shaped or zigzag markings on a whitish background; hinge with three teeth, the anterior one narrow and close against the margin; pallial sinus very small or almost obsolete; margin crenulated but often smooth posteriorly; interior white.

A large specimen from Culebra Bay, Costa Rica, measures approximately 50 mm. in length and 45.5 mm. in height.

The shell of this species is less tumid and has many more concentric ridges than that of *Anomalocardia subimbricata tumens* Verill. Both *Anomalocardia subimbricata* and the subspecies *tumens* differ from *A. subrugosa* Wood in lacking a decided posterior rostration and posterior dorsal groove and in possessing bifurcated radial ribs and a low radial riblet in the major interspaces.

Anomalocardia subrugosa Manger,⁶³ de- "Type Locality: San Quintin Bay, Lower California." Described from the Pleistocene of San Quintin Bay, Lower California, was said to differ from *A. subimbricata* in the possession of concentric lamellae between the major ridges. *Venus subrugosa* Wood, 1828, is now placed in the genus *Anomalocardia*; therefore the species described by Manger, 1934, as *Anomalocardia subrugosa* requires a new name. The name *Anomalocardia mangeri* is here proposed for Manger's species.

Pilsbry & Olsson have referred the species here cited as *Anomalocardia subimbricata* to the genus *Chione*. It is not a typical form of *Anomalocardia* but on the other hand it seems as well placed here as in *Chione*.

Distribution: Specimens of *Anomalocardia subimbricata* were collected on beaches and dredged at depths of 1.5 to 5 fathoms, from Banderas Bay, Mexico, to the Gulf of Chiriqui, Panama. This species has a generally more southern distribution than that of the subspecies *A. subimbricata tumens*

⁶¹ Jukes-Browne, A. J., Proc. Malacol. Soc. London, Vol. 11, Pt. 2, June, 1914, p. 80.

⁶² Not represented in the present collection.

⁶³ *Anomalocardia subrugosa* Manger, Johns Hopkins Studies in Geol., No. 11, 1934, p. 299, pl. 21, figs. 3 and 4.

and occurs chiefly south of the Gulf of California. It also has been recorded as occurring from Pliocene to Recent in the Gulf of California region, in the Quaternary of Ecuador and in the Pleistocene of Peru.

Specimens from the West Falkland Islands in the south Atlantic Ocean were identified as "*Cryptogramma subimbricata*" by Melville & Standen⁶⁴ who stated that the occurrence was adventitious. If correctly identified that no doubt would be the right interpretation because that locality is far beyond the range of the present species, which inhabits warm water.

***Anomalocardia subimbricata tumens* Verrill.**

Chione tumens Verrill, Amer. Jour. Sci., Vol. 49, No. 146, March, 1870, p. 222. "La Paz,—Capt. J. Pedersen."

Type Locality: La Paz, Lower California, Mexico.

Range: Magdalena Bay, Lower California, to the Gulf of California.

Collecting Stations: Mexico: Ceralbo Island, Gulf of California; Cape San Lucas, Lower California.

Description: Shell rather tumid; ornamentation similar to that of *Anomalocardia subimbricata* except that there are only about 6-8 heavy, concentric, step-like ridges.

Judging from the illustration and the description there appear to be but slight differences between *Chione* (*Chione*) *vaca* Olsson,⁶⁵ described from the Pliocene of Panama, and *Anomalocardia subimbricata tumens*.

Distribution: *Anomalocardia subimbricata tumens* appears to be confined to the Gulf of California and the southern part of the west coast of Lower California. There is overlapping in the ranges of this subspecies and *A. subimbricata* but the two forms, for the most part, appear to be readily separable.

***Anomalocardia subrugosa* Wood.**

Venus subrugosa W. Wood, Index, Test., Suppl., *Venus*, 1828, p. 5, pl. 2, fig. 6. "Panama."—Sowerby, Gen. Rec. and Foss. Shells, No. 41, 1834, pl. 250, fig. 2, pl. 251, fig. 5.—Reeve, Conch. Icon., Vol. 14, *Venus*, 1863, species 86, pl. 19, fig. 86. West Colombia (Cuming).

Not *Venus subrugosa* Bronn, Ergeb. Nat. Reisen, Vol. 2, 1831, p. 607.

Anomalocardia subrugosa Sowerby, Dall, Proc. U. S. Nat. Mus., Vol. 37, 1909, pp. 158, 269, pl. 26, fig. 3. Gulf of California to Valparaiso, Chile.—Pilsbry & Lowe, Proc. Acad. Nat. Sci. Philadelphia, Vol. 84, 1932, p. 134. Localities cited from Guaymas, Mexico, to Santa Elena Bay, Costa Rica.

Not *Anomalocardia subrugosa* Manger, 1934. [= *Anomalocardia mangeri* nom. nov.].

Type Locality: Magdalena Bay to the Gulf

⁶⁴ Melville, J. C., and Standen, R., Ann. & Mag. Nat. Hist., Ser. 8, Vol. 18, 1914, p. 133.

⁶⁵ *Chione* (*Chione*) *vaca* Olsson, Bull. Amer. Paleo., Vol. 27, Bull. No. 106, December 25, 1942, p. 192 (40)., pl. 18 (5), fig. 7. "Rio La Vaca. Quebrada Melissa." Panama. Pliocene.

of California and south to Boca Pan near Zorritos, Peru. To Valparaiso, Chile (Dall).

Collecting Stations: Mexico: Cape San Lucas, Lower California; Chamela Bay; Tenacatita Bay; Nicaragua: Potosi and Monypenny Point; Corinto (200-D-19), 3 fathoms, mud, mangrove leaves, also beach, Castanones peninsular lagoon and Isla Encantada; Costa Rica: Port Parker; Culebra Bay; Port Culebra; Jasper Island; Panama: Bahia Honda; Colombia: Gorgona Island.

Description: Shell triangularly ovate, somewhat rostrate posteriorly; ornamented by numerous concentric ridges which are crossed by fine incised radial lines; a shallow radial groove from the beak to the ventral margin is present just anterior to the posterior margin; the lunule which is cordate and bounded by a fine incised line and the escutcheon which is elongate are both ornamented only by lines of growth; exteriorly a white or cream colored background is nearly always crossed by 3 (occasionally 4) dark radial rays; hinge with three cardinal teeth in each valve; pallial sinus very short; margin finely crenulated; interior dorsal area purplish-black, the remainder white or with purple areas.

A large specimen from Port Parker, Costa Rica, measures approximately 46 mm. in length.

The presence of a well developed posterior dorsal radial groove easily serves to separate this species from *Anomalocardia subimbricata*. Some of the large nearly smooth specimens collected at Port Parker, Costa Rica, are very similar to *A. broggi* Pilsbry & Olsson⁶⁶ which was described from Peru. A well developed posterior dorsal fold and groove is present from beak to base on the present specimens. According to Pilsbry & Olsson a corresponding fold is well developed only near the beaks on *A. broggi* but is otherwise absent or feebly developed. Their species was described as possessing well developed concentric sculpture only near the beaks and on the anterior submargins.

Anomalocardia paziana Fischer⁶⁷ was described from Panama but it was not stated whether from the east or west coast of that country. The other species described in the same article are from east American waters. The illustration is that of a small elongated posteriorly rostrate form with concentric ridges and a posterior radial depression. We have not seen any west American specimens that could be referred to it but it bears some resemblance to *A. cuneiformis* Conrad, an east American species. Two species occurring fossil in western South America have been described, *Anomalocardia anomiana* Olsson from the Miocene of Peru, and *A. callistoides* Pilsbry & Olsson from the Pliocene of Ecuador.

⁶⁶ *Anomalocardia broggi* Pilsbry & Olsson, Nautilus, Vol. 56, No. 3, January, 1943, p. 78, pl. 8, fig. 7. Type "from Bayovar, Sechura, north Peru." Also, Zaramilla, Peru.

⁶⁷ *Anomalocardia paziana* Fischer, Journ. de Conchyl., Vol. 7, 1858, p. 186, pl. 7, figs. 9, 10. "Hab. Panama (Paz)." Coll. du Journal."

Distribution: *Anomalocardia subrugosa* was collected on beaches and in shallow water from Cape San Lucas to Colombia. It has been recorded as occurring in the Pleistocene of Lower California and in the Quaternary of Peru.

Genus *Compsomyax* Stewart.

Compsomyax subdiaphana Carpenter.

Clementia subdiaphana Carpenter, *Rept. Brit. Assoc. Adv. Sci.* for 1863 (issued August, 1864), pp. 602, 607, 640. "Vanc[ouver]. Is." Reprint in *Smithson. Miscell. Coll.*, No. 252, 1872, pp. 88, 93, 126.—Dall, *Proc. U. S. Nat. Mus.*, Vol. 14, 1891, p. 185, pl. 7, figs. 5 and 6. Cited from Port Etches, Alaska, in 14-60 fathoms, to off Drake's Bay, California, in 24 fathoms.

Marcia subdiaphana Carpenter, I. S. Oldroyd, *Stanford Univ. Publ. Univ. Ser. Geol. Sci.*, Vol. 1, 1924, p. 155, pl. 33, fig. 3; pl. 38, fig. 1. Range, Sannakh Islands, Alaska, to Santa Barbara Islands and San Pedro, California.

Clementia (Compsomyax) subdiaphana Carpenter, Grant & Gale, *Mem. San Diego Soc. Nat. Hist.*, Vol. 1, 1931, p. 334, pl. 17, figs. 10a, 10b, ?15. Earlier records cited. Miocene to Recent.

Type Locality: Vancouver Island, British Columbia.

Range: Sannakh Islands, Alaska, to Cedros Island, Lower California.

Collecting Station: Mexico: East of Cedros Island (126-D-3, 4), 40 fathoms, mud.

Description: Shell elongately ovate, varying in outline and ventricosity, beaks anterior and pointing forward; sculpture consisting of fine concentric lines of growth; lunule broad, faintly defined; hinge with three cardinal teeth in each valve, the right posterior cardinal deeply bifid; pallial sinus ascending and extending forward less than one-half the length of the shell; interior margins smooth.

A very large specimen from Port Ludlow, Washington, in Puget Sound, in the Hempill collection of the California Academy of Sciences, measures, 68.8 mm. in length, 58 mm. in height, and 40.3 mm. in convexity (both valves).

Distribution: Four specimens of this species were dredged by the expedition east of Cedros Island in 40 fathoms. The occurrence of the species at this locality is an extension south of the known range. It is known to occur from Pliocene to Recent in western America and perhaps also in the Miocene.

Genus *Protothaca* Dall.

Key to the subgenera of *Protothaca*.

- A. Escutcheon well developed on left valve *Protothaca* s.s.⁶⁸
- B. Escutcheon lacking or nearly so on left valve *Callithaca*

⁶⁸ Not represented in the present collection.

Subgenus *Callithaca* Dall.

Key to the species of *Callithaca*.

- A. Pallial sinus extends forward more than $\frac{1}{2}$ the length of the shell *staminea*
- B. Pallial sinus extends forward less than $\frac{1}{2}$ the length of the shell *grata*

Protothaca (Callithaca) grata Say.

Venus grata Say, *Amer. Conch.*, No. 3, September, 1830, [pages of text not numbered] pl. 26, [three figures] ... "West coast of Mexico."—Reeve, *Conch. Icon.*, Vol. 14, *Venus*, 1863, species 8, pl. 3, figs. 8a, 8b. [Not the locality "Gulf of Mexico"].

Venus histrionica Sowerby, *Proc. Zool. Soc. London*, June 1, 1835, p. 41. "Hab. apud Real Llejos, Americae Centralis, et ad Sanctam Elenam." "Found in muddy sand at low water."—Sowerby, *Thes. Conch.*, Vol. 2, 1853, p. 714, pl. 155, fig. 52. "Found in sandy mud at a depth of thirteen fathoms, Guacamayo, Central America. Cuming."

Venerupis (Protothaca) grata Say, Grant & Gale, *Mem. San Diego Soc. Nat. Hist.*, Vol. 1, 1931, p. 328. Earlier references cited. Pleistocene and Recent.

Type Locality: West coast of Mexico.

Range: Cape Colnett, west coast of Lower California (Lowe), to the Gulf of California and south to Antofogasta, Chile.

Collecting Stations: Mexico: Banderas Bay; Tangola-Tangola Bay; Nicaragua: Potosi and Monypenny Point; Isla Encantada and Isla Cardon, Corinto; San Juan del Sur; Costa Rica: Port Parker; Culebra Bay; Ballenas Bay; Golfito Bay; Panama: Isla Parida; Colombia: Gorgona Island.

Description: Shell elongately ovate, often 30-50 mm. in length, moderately inflated, ornamented by many flattish radial ribs which are coarser anteriorly, separated by narrow interspaces and both crossed by usually weaker concentric imbrications and irregularities due to growth; lunule cordate or elongated, ornamented by fine, radial ribs; escutcheon absent or only slightly developed, ligament deeply sunken; the color pattern varies greatly from blackish-brown to striped or checked brown and white to almost wholly white; the middle cardinals and usually the right posterior cardinal grooved; pallial sinus ascending, end rounded or roundly pointed, directed toward center of anterior adductor impression, projecting about one-third the distance between the two impressions; margin crenulated; color of interior white and purple or often wholly purple.

Specimens of this species are usually about 40 mm. in length but a large specimen in the collection of the California Academy of Sciences is 50 mm. in length. In this specimen the pallial sinus projects anteriorly 21 mm. from the posterior margin.

The shell of *Protothaca grata* differs from that of *P. staminea* Conrad in the shorter pallial sinus, brighter color patterns and in the generally smaller size. This species has received many different names in the literature due in great part to the variable color

pattern. Grant & Gale (1931) have cited many of the names now placed in the synonymy of this species.

The almost complete absence of an escutcheon, smaller lunule, less rasp-like sculpture of the ribs, usually more inflated shell and narrower hinge plate are features which serve to separate *Protothaca grata* from *Chione asperima* Sowerby.

Some specimens of this species bearing a small escutcheon on the left valve are strongly suggestive of the subgenus *Nioche* but on most of these shells the left anterior cardinal is less elongate and the hinge plate is narrower than it is in typical species of that subgenus.

Distribution: This species was collected at many localities, usually between tides, from west Mexico to Colombia. It has been reported as occurring in the Pleistocene of Magdalena Bay, Lower California, and in the Pliocene of the Galápagos Islands.

Protothaca (Callithaca) staminea Conrad.

Venus staminea Conrad, *Jour. Acad. Nat. Sci. Philadelphia*, Vol. 7, 1837, p. 250, pl. 19, fig. 15. "Inhabits the coast of California, with the above" [that is, *Venus nuttalli* from "Sta. Barbara, and Sta. Diego"].

Paphia staminea Conrad, I. S. Oldroyd, *Stanford Univ. Publ. Univ. Ser. Geol. Sci.*, Vol. 1, 1924, p. 156, pl. 35, figs. 1a, 1b. Range, Commander and Aleutian Islands to Puget Sound and Socorro Island, Japan. Also Miocene to Recent.

Venerupis (Protothaca) staminea Conrad, Grant & Gale, *Mem. San Diego Soc. Nat. Hist.*, Vol. 1, 1931, p. 329, pl. 18, figs. 1a, 1b, 2a, 2b. Earlier records cited. Miocene to Recent.

Type Locality: San Diego, California (here designated as type locality). Santa Barbara and San Diego, California, indicated at the time of original description.

Range: Aleutian Islands to Cape San Lucas, Lower California. Socorro Island (Dall).

Collecting Station: Mexico: Cape San Lucas, Lower California.

Description: Shell elongately ovate, often 40 to 65 mm. in length, moderately inflated, ornamented by radial and concentric sculpture, the radial usually the stronger; lunule lanceolately cordate, sometimes only faintly defined; color yellowish-gray with varying amounts of wavy brown concentric lines or spots; ligament sunken, escutcheon absent or only faintly indicated; right posterior and middle teeth of both valves grooved; pallial sinus long, rather narrow, rounded at the end or blunt, projecting anteriorly more than one-half the distance between the two adductor impressions; margin crenulated; color of interior usually white but some southern specimens are partly purple and white.

A large specimen of this species in the collection of the California Academy of Sciences collected by Henry Hemphill at Turtle

Bay, Lower California, measures: length, 75.5 mm.; height, 64 mm.; convexity (both valves) 44.5 mm.; pallial sinus projects anteriorly 44 mm. from the posterior margin.

The longer pallial sinus, less brilliant and less variable color pattern and the generally larger size all serve to separate *Protothaca staminea* from *P. grata* Say.

Smith⁶⁹ has discussed the ecology and growth of *Protothaca staminea*.

Distribution: A single specimen of this species was collected on the beach at Cape San Lucas, Lower California. In California the species has been recorded from upper Miocene to Recent. It has been pointed out by Keen⁷⁰ that the species recorded from Japan under the name of *P. staminea* can be referred to *P. euglypta* Sowerby. Bales⁷¹ cited *P. staminea* from Acapulco but we have not seen specimens from south of Cape San Lucas. Eyerdam⁷² cited it from Arica, Peru, but it seems probable that the South American record can be referred to *P. thaca* Molina or some other species.

Genus *Irus* Oken.

Key to the subgenera of *Irus*.

- A. Lunule bounded by an incised line; margin crenulated *Paphonotia*
- B. Lunule not bounded by an incised line; margin smooth *Irus s.s.*⁷³

Subgenus *Paphonotia* Hertlein & Strong, subgen. nov.

Type: *Petricola elliptica* Sowerby, 1834.

Shell variable in shape but usually elliptically oblong, beaks anteriorly situated, rather compressed; sculptured with rather distantly spaced concentric lamellae and fine radial riblets which are usually reduced or lacking on the posterior area; lunule defined by an incised line; escutcheon usually well defined on the left valve; teeth small, hinge of left valve with a posterior cardinal moderately strong and fused to the margin, middle cardinal shorter and strongly grooved, anterior cardinal longer than middle tooth and slanting strongly forward; hinge of right valve with posterior and median cardinals about the same length, the median one grooved, and an anterior cardinal almost parallel to the lunular margin; pallial sinus ascending, angular, usually not extending quite to the middle of the shell; exterior usually whitish, interior white, posteriorly brown and often the anterior adductor impression and hinge brown, and sometimes the interior of the shell is wholly brown.

Compared to *Irus s.s.*, which has as type *Donax irus* Linnaeus, the shell of *Paphonotia* has the lunule delimited by a well marked in-

⁶⁹ Smith, G. M., *Trans. Roy. Soc. Canada*, Sect. 5, Vol. 27, 1933, pp. 229-245.

⁷⁰ Keen, A. M., *Sixth Pac. Sci. Congress*, Vol. 3, 1941, p. 480.

⁷¹ Bales, B. R., *Nautilus*, Vol. 52, No. 2, 1938, p. 45.

⁷² Eyerdam, W. J., *Nautilus*, Vol. 58, No. 3, 1940, p. 108.

⁷³ Not represented in the present collection.

cised line, the teeth are more diverging, the inner margin is crenulated and the pallial sinus is angular. Grant & Gale, 1931, pointed out that some west American shells referred to the genus *Venerupis* Lamarck, which has as type *Venus perforans* Montagu, bear considerable resemblance to some species referred to *Irus*.

The species described as *Petricola elliptica* by Sowerby has been referred by some writers to *Petricola* and by others to *Venerupis*. It does not seem to be exactly referable to either of those genera. Some of the specimens in the present collection possess features in common with *Venerupis elegans* Deshayes, the type of *Notopaphia* Oliver⁷⁴ as illustrated by Marwick. The west American species possesses different sculpture and appears to differ in some other details and therefore we have thought it desirable to propose a new subgeneric name *Paphonotia*⁷⁵ with *Petricola elliptica* Sowerby as type.

The similarity of *Paphonotia* to *Notopaphia* of New Zealand is not surprising when it is recalled that *Protothaca* is present in New Zealand (Marwick, 1927, p. 623). Furthermore it appears that the west American species *Chione fluctifraga* Sowerby is very similar to the New Zealand species, *Venus stutchburyi* Gray, and may perhaps be referable to the same subgenus, *Austrovenus* Marwick⁷⁶.

Irus (Paphonotia) ellipticus Sowerby.

Petricola elliptica Sowerby, Proc. Zool. Soc. London, September 26, 1834, p. 46. "Hab. ad Paytam." "Found in hard mud at low water."—Sowerby, Thes. Conch., Vol. 2, 1854, p. 774, pl. 164, fig. 3; pl. 166, fig. 10. Original locality cited.—Sowerby, Conch. Icon., Vol. 19, *Petricola*, 1874, species 12, pl. 2, fig. 10. Original locality cited.

Venerupis elliptica Sowerby, Lamy, Journ. de Conchyl., Vol. 67, No. 4, 1923, p. 306, two figs. p. 307. Peru.

Petricola solida Sowerby, Proc. Zool. Soc. London, September 26, 1834, p. 46. "Hab ad oras Peruviae. (Lambeyeque)." "Found in hard clay and stones at low water."—Sowerby, Thes. Conch., Vol. 2, 1854, p. 774, pl. 166, fig. 9. Original locality cited.—Sowerby, Conch. Icon., Vol. 19, *Petricola*, 1874, species 15, pl. 2, fig. 15. Original locality cited.

Petricola solidula Sowerby, Thes. Conch., Vol. 2, 1854, p. 770, pl. 164, fig. 17.

Type Locality: Paita, Peru, at low water, in hard mud.

Range: Tangola-Tangola Bay, Mexico, to Arica, Chile.

⁷⁴ *Notopaphia* Oliver, Proc. Malacol. Soc. London, Vol. 15, Pt. 4, March, 1923, p. 185. Type: *Venerupis elegans* Deshayes, fig. p. 185. [Originally described in Proc. Zool. Soc. London for 1853 (issued June 27, 1854)], p. 5, pl. 18, figs. 2a, 2b, 2c. "Hab. New Zealand. Coll. Cuming."—Marwick, Trans. New Zealand Inst., Vol. 57, February 12, 1927, p. 662. Type: *Venerupis elegans* Deshayes. Illustrated on pl. 49, figs. 174, 176, 177. New Zealand.

⁷⁵ *Paphonotia*, an anagram of *Notopaphia*.

⁷⁶ *Austrovenus* Marwick, Trans. New Zealand Inst., Vol. 57, February 12, 1927, p. 620. "Type: *Venus stutchburyi* Grav." Illustrated on pl. 47, figs. 158, 159, 160. Recent, also fossil in New Zealand.

Collecting Station: Nicaragua: Corinto (200-D-19), 12-13 fathoms, mangrove leaves.

Description: Shell elliptically oblong, beaks in front of the middle, rather compressed; ornamented by rather distantly spaced concentric lamellae and by moderately fine, closely spaced radial ribs which however, are usually much reduced or lacking on the posterior area; lunule defined by an impressed line; right posterior and middle tooth and left middle tooth are medially grooved; pallial sinus angular, ascending, not reaching quite the middle of the shell; interior brown and white or almost wholly brown; margin crenulated.

The specimens of this species in the present collection are small, not over 10 mm. in length, but large specimens attain a length of 26 mm. or more.

The shell of this species is variable in shape due to the fact that it lives in holes in rocks. Some young specimens that are elliptical in shape later develop into forms vertically truncated posteriorly. The strongly frilled and squarely truncated form was named *Venerupis foliacea* by Deshayes⁷⁷. It appears to be of not more than subspecific value. Dall, 1902, stated that synonyms of this form include *Tapes squamosa* Carpenter, 1857, *Venus troglodytes* Mörcz, 1861, and perhaps *Venerupis paupercula* Deshayes, 1853.

The species described as *Venerupis oblonga* Sowerby⁷⁸ appears to be a very similar form but may differ in possessing stronger radial ornamentation on the posterior portion of the valves.

Distribution: Specimens of this species were dredged by the expedition at Corinto, Nicaragua, in 12-13 fathoms. It has been reported as ranging south to Chile. The subspecies *foliaceus* has been recorded as occurring north to Mazatlan, Mexico.

Genus *Psephidia* Dall.

Psephidia cymata Dall.

Psephidia cymata Dall, Proc. U. S. Nat. Mus., Vol. 45, No. 2002, June 11, 1913, p. 593. "Near Cerros Island, Lower California, in shallow water."—Dall, U. S. Nat. Mus., Bull. 112, 1921, p. 44, pl. 3, fig. 2. Santa Barbara Islands, California, to the Gulf of California.

Type Locality: Near Cedros Island, Lower California, in shallow water.

Range: Santa Barbara Islands, California, to the Gulf of California.

⁷⁷ *Venerupis foliacea* Deshayes, Proc. Zool. Soc. London for 1853 (issued June 27, 1854), pl. 18, figs. 5a, 5b. [Without description].—Sowerby, Thes. Conch., Vol. 2, 1854, p. 764, pl. 164, figs. 8, 9. "Mazatlan." Not *Venus foliacea* Philippi, 1846.

⁷⁸ *Petricola oblonga* Sowerby, Proc. Zool. Soc. London, September 26, 1834, p. 46. "Hab ad oras Peruviae. (Pacos-avavo)." "Found in hard mud at low water."—Sowerby, Thes. Conch., Vol. 2, 1854, p. 765, pl. 165, fig. 21 (as *Venerupis oblonga*). Original locality cited.

Venerupis fernandesiana Stempell (Zool. Jahrb., Suppl. Bd. 5, Fauna Chilensis, Bd. 2, Heft 1, December 1898, p. 237, pl. 12, figs. 22, 23. "Fundort: Zahlreiche Exemplare aus Juan Fernandez (Bahia Cumberland)"). was questionably referred to *V. oblonga* by Dall.

Collecting Station: Mexico: East of Cedros Island (126-D-12), 45 fathoms, crushed shell, mud.

Description: Shell small, about 6 mm. in length and 5.5 mm. in height; white, rounded triangular, somewhat anterior beaks; lunule and escutcheon feebly indicated; ornamented by fine concentric low thread-like sculpture; interior polished; three cardinals in each valve; pallial sinus small, ascending, inner extreme bluntly rounded; inner margin smooth; periostracum yellowish, rather coarse (adapted from Dall).

Distribution: A few somewhat worn specimens dredged east of Cedros Island in 45 fathoms appear to be referable to this species. It also has been recorded as occurring in the Pleistocene of Lower California.

FAMILY PETRICOLIDAE.

Genus *Petricola* Lamarck.

Key to the subgenera of *Petricola*.

- A. Radial sculpture nearly uniform over shell *Petricola* s.s.
- B. Radial sculpture much coarser anteriorly; subcylindrical *Petricolaria*

Subgenus *Petricola* s.s.

Key to the species of *Petricola* s.s.

- A. Shell usually attenuated posteriorly; radial sculpture strong *robusta*
- B. Shell usually subquadrate or subrounded; radial sculpture fine
 - a. Length usually not exceeding 12 mm. *tellimyalis*⁷⁹
 - aa. Length exceeding 12 mm.
 - b. Interior white *carditoides*⁷⁹
 - bb. Interior blackish-brown *lucasana*

Petricola (*Petricolaria*) *lucasana* Hertlein & Strong, sp. nov.

Plate II, Figures 4 and 9.

Shell oblong, subquadrate or subrounded, thick; ornamented by fine radial riblets; exterior white with bluish tinged concentric areas and reddish or brown near the beaks; interior blackish-brown, sometimes whitish under the umbos; pallial sinus short, broad, rounded; margin smooth; hinged normal for the genus. Dimensions: length, 24.6 mm.; height, 25 mm.; convexity (both valves), 16.6 mm.

Holotype, (Calif. Acad. Sci. Paleo. Type Coll.), from Cape San Lucas, Lower California, Mexico.

This species, in some cases, has been referred to *Petricola robusta* Sowerby but it differs from that species in the oblong or subquadrate shape of the shell which does not taper posteriorly and is less inflated anteriorly, the thicker shell, and in the much finer and nearly uniform radial sculpture. Specimens of *Petricola robusta* dredged by G. D. Hanna and E. K. Jordan in 10 fathoms at Maria Madre Island, Tres Marias group, agree exactly with Sowerby's illustrations

of that species and show it to be quite different from the present species.

This new species resembles *Petricola carditoides* Conrad⁸⁰ which has been reported as ranging from Vancouver Island, British Columbia, to Magdalena Bay, Lower California, but differs in the slightly coarser sculpture, blackish-brown interior and whitish and dark orange brown exterior.

This species occurs in the Gulf of California, at least as far north as Punta Penasco, Sonora, Mexico, where it was collected by H. N. Lowe.

Petricola (*Petricolaria*) *robusta* Sowerby.

Petricola robusta Sowerby, Proc. Zool. Soc. London, September 26, 1834, p. 47. "Hab. ad Panamam et ad Insulam Muerte dictam." "Found in rocks at the depth of from six to eleven fathoms."—Sowerby, Thes. Conch., Vol. 2, 1854, p. 775, pl. 166, figs. 16, 17. "In rocks, six to eleven fathoms, at Panama. Cuming."—Sowerby, Conch. Icon., Vol. 19, *Petricola*, 1874, species 20, pl. 3, figs. 20a, 20b. Panama.—Lamy, Journ. de Conchyl., Vol. 67, No. 4, 1923, p. 330. Gulf of California and Panama.

Type Locality: Panama (here designated as type locality). Island of Muerte also cited originally.

Range: Gulf of California to Guayaquil, Ecuador.

Collecting Stations: Mexico: Tangola-Tangola Bay; Nicaragua: Corinto (200-D-19), 12-13 fathoms, mangrove leaves.

Description: Of a dull orange tint, with purple at the apices and blackish inside, rather thick, very globose in front, tapering behind, where the valves are unequal, the right valve slightly overwrapping. The radiating striae are distant, numerous, and close in front, but towards the back become separated, strong, acute; the hinder ones of all are a little smaller, serrated, and their ends form a denticulated edge (Sowerby, Thes. Conch.).

The pallial sinus is short, broad, rounded at the end; hinge normal for the genus.

Petricola sinuosa Conrad, 1849. *P. bulbosa* Gould, 1851, and *P. venusta* De Folin, 1867, are names now relegated to the synonymy of *P. robusta*.

Petricola typica Jonas, a Caribbean species, has a similar shell but the interior is white. *Petricola riocanensis* Maury, 1917, described from the Miocene of Santo Domingo, is also a similar species.

Distribution: A few specimens, mostly young, referred to this species, were taken off west Mexico and Nicaragua. This species has been recorded from South Africa but as pointed out by Bartsch⁸¹ it does not occur in that region.

⁷⁹ *Saxicava carditoides* Conrad, Jour. Acad. Nat. Sci. Philadelphia, Vol. 7, 1837, p. 255, pl. 20, fig. 8. "Inhabits California near Sta. Barbara, where a single valve was collected."

⁸⁰ *Petricola carditoides* Conrad, I. S. Oldroyd, Stanford Univ. Publ. Univ. Ser. Geol. Sci., Vol. 1, 1924, p. 163, pl. 34, figs. 6a, 6b. Range, Vancouver Island to Lower California.

⁸¹ Bartsch, P., U. S. Nat. Mus., Bull. 91, 1915, p. 247.

⁷⁹ Not represented in the present collection.

Subgenus *Petricolaria* Stoliczka.Key⁸² to the species of *Petricolaria*.

A. A flattened lunule-like area present

- a. Height nearly one-half the length
 - b. Teeth in right valve massive; shell fairly thick *cognata*⁸³
 - bb. Teeth in right valve moderately fine; lunule-like area and nymphs narrower *pholadiformis*⁸³
- aa. Height about one-third the length or less *parallela*

B. Lunule-like area lacking

- a. Anterior end evenly rounded; pallial sinus rounded at end; shell thin *californiensis*⁸³
- aa. Anterior end tapering to a narrow point; pallial sinus angular, tapering to a point; shell fairly thick, partly purplish-brown *denticulata*⁸³

Petricola (Petricolaria) parallela

Pilsbry & Lowe.

Petricola gracilis parallela Pilsbry & Lowe, Proc. Acad. Nat. Sci. Philadelphia, Vol. 84, May 21, 1932, p. 99, pl. 13, figs. 4, 5, 5a, 6. "Nicaragua: Corinto (Lowe)." Type.

Type Locality: Corinto, Nicaragua.

Range: Scammon Lagoon, Lower California, to the Gulf of California and south to Corinto, Nicaragua.

Collecting Station: Nicaragua: Corinto (200-D-11), 8 fathoms, sand.

Description: Shell very elongated, dorsal and ventral margins nearly parallel; sculptured with 11-13 coarse, nodulous ribs on the anterior half, posteriorly the ribs diminish to radial striae; lunular region somewhat excavated and ornamented by fine growth lamellae; pallial sinus long, of equal width throughout, rounded at end.

The specimen in the present collection is only about 24 mm. long but agrees exactly with larger shells of this species.

Petricola parallela is very similar to *Petricola gracilis* Deshayes⁸⁴, a species originally described without information as to the locality from which it came. As pointed out by Pilsbry & Lowe there are differences in the shape, ribbing and apparently in the pallial sinus of the two forms.

Compared to *Petricola pholadiformis* Lamarck, an east American species, the shell of the present species is more elongated and the dorsal and ventral margins are more nearly parallel.

Some of the records of *Petricola cognata*⁸² Adapted from Pilsbry & Lowe.⁸³ Not represented in the present collection.

⁸⁴ *Petricola gracilis* Deshayes, Cat. Conchif. or Bivalve Shells in Coll. Brit. Mus., Pt. 1, 1853, p. 214. "Hab. —? Shells in Coll. Cuming."—Deshayes, Proc. Zool. Soc. London for 1853 (issued June 27, 1854), pl. 18, figs. 9, 9a. [No description].—Sowerby, Thes. Conch., Vol. 2, 1854, p. 772, pl. 166, fig. 12. "Hab. —? Cuming's collection."—Lamy, Journ. de Conchyl., Vol. 67, No. 4, 1928, p. 344.

C. B. Adams cited⁸⁵ from the Gulf of California region undoubtedly can be referred to *P. parallela*. *Petricola cognata* C. B. Adams⁸⁶ was described from Panama. Pilsbry & Lowe illustrated the type and stated that it resembles *P. pholadiformis* Lamarck but differs in possessing more massive teeth in the right valve, broader nymphs and in the wider lunule-like area free of radiating sculpture.

Distribution: A single small specimen of this species was dredged in 8 fathoms at Corinto, Nicaragua. It also has been cited⁸⁷ as occurring in the Pleistocene of the Newport Bay region in southern California.

FAMILY COOPERELLIDAE.

Genus *Cooperella* Carpenter.

Oedalia Carpenter, Rept. Brit. Assoc. Adv. Sci. for 1863, issued August, 1864, pp. 611, 639. "*Oedalia (Cooperella) scintillaeformis*, n. subgen., n. s." (p. 611) [No description]; "*Oedalia subdiaphana*, n. g., n. s." (p. 639) [Description]. Reprint in Smithson. Miscell. Coll., No. 252, 1872, pp. 97, 125.—Carpenter, Journ. de Conchyl., Vol. 12 (Ser. 3, Vol. 5), April, 1865, p. 134. "*Oedalia*, n.g." [*Oedalia subdiaphana* described]. Reprint in Smithson. Miscell. Coll., No. 252, 1872, p. 134.

Not *Oedalia* Meigen, 1820. Dipt.

Cooperella Carpenter, Rept. Brit. Assoc. Adv. Sci. for 1863 issued August, 1864, pp. 611, 639. "*Oedalia (Cooperella) scintillaeformis*, n. subg., n. s." (p. 611) [no description]; "*Cooperella scintillaeformis*, n. s. New subgenus of *Oedalia*" (p. 639) [no description]. Reprint in Smithson. Miscell. Coll. No. 252, 1872, pp. 97, 125.—Dall, Trans. Wagner Free Inst. Sci., Vol. 3, Pt. 5, December, 1900, p. 1061. "The type *Cooperella subdiaphana* (+ *scintillaeformis*) Cpr."

Not *Cooperella* Gunnell, Jour. Paleo., Vol. 7, No. 3, 1933, p. 291. Pisces.

Oedalina Carpenter, Proc. Calif. Acad. Nat. Sci., Vol. 3, February, 1865, p. 208. New name for *Oedalia* Carpenter, preoccupied.—Lamy, Journ. de Conchyl., Vol. 61, No. 3, 1914, p. 301.

Type (by monotypy): *Cooperella scintillaeformis* Carpenter.

Shell small, very thin, white, ovately rectangular, moderately inflated, beaks a little anterior, smooth or concentrically striated; resilium narrow, depressed, behind and separated from the teeth by a thin plate; hinge of right valve with 2 cardinals, left valve with 3 cardinal teeth, the left middle and usually the right posterior, and frequently the other teeth, bifid; pallial sinus deep, wide, broadly rounded at the end; margins smooth.

⁸⁵ *Petricola cognata* C. B. Adams, E. K. Jordan, Bull. South. Calif. Acad. Sci., Vol. 23, Pt. 5, September-October (issued October 28), 1924, p. 153. The record "Scammon's Lagoon," Lower California, can be referred to *P. parallela*.

⁸⁶ *Petricola cognata* C. B. Adams, Ann. Lyceum Nat. Hist. New York, Vol. 5, July, 1852, pp. 510, 546 (separate pp. 286, 322). "Habitat—Panama."—Pilsbry & Lowe, Proc. Acad. Nat. Sci. Philadelphia, Vol. 84, 1932, p. 99, pl. 13, figs. 10, 11. Figure of type Panama.

⁸⁷ See Bruff, S. C., Univ. Calif. Publ., Bull. Dept. Geol. Sci., Vol. 27, No. 6, 1946, p. 232.

This genus has been recorded as occurring from Miocene to Recent in the Caribbean region and Pleistocene and Recent in the eastern Pacific. One species, "*Oedalina asiatica*" Melvill, 1899, doubtfully referred to the genus, was described from the Arabian Sea.

A subgenus, *Cooperellopsis* Woodring⁸⁸, 1925, described from the Miocene of Bowden, Jamaica, possesses a subequilateral, strongly inflated shell in which the left middle cardinal is only obscurely bifid rather than strongly so as in *Cooperella* s.s.

***Cooperella subdiaphana* Carpenter.**

Oedalia subdiaphana Carpenter, Rept. Brit. Assoc. Adv. Sci. for 1863 (issued August, 1864), p. 639. Region between San Diego and San Pedro, California. Also Santa Barbara Islands, California. Reprint in *Smithson. Miscell. Coll.*, No 252, 1872, p. 125.—Carpenter, *Journ. de Conchyl.*, Vol. 12 (Ser. 3, Vol. 5), April, 1865, p. 134. "Hab. San Diego, Cassidy."

Oedalia (Cooperella) scintillaeformis Carpenter, Rept. Brit. Assoc. Adv. Sci. for 1863 (issued August, 1864), p. 611. [No description]. San Diego. Santa Barbara Islands. Reprint in *Smithson. Miscell. Coll.*, No. 252, 1872, p. 97.

Cooperella scintillaeformis Carpenter, Rept. Brit. Assoc. Adv. Sci. for 1863 (issued August, 1864), p. 639. Region between San Pedro and San Diego, California. Also Santa Barbara Islands. Reprint in *Smithson. Miscell. Coll.*, No. 252, 1872, p. 125.—Carpenter, *Proc. Calif. Acad. Nat. Sci.*, Vol. 3, February, 1865, p. 208. "Hab. San Diego; San Pedro, 2 dredged in 8-20 fms. Cooper."

Cooperella subdiaphana Carpenter, Arnold, *Mem. Calif. Acad. Sci.*, Vol. 3, 1903, p. 153, pl. 13, fig. 1. Vancouver Island to Todos Santos Bay (Dall). Also San Pedro and San Diego, California, Pleistocene. — Lamy, *Journ. de Conchyl.*, Vol. 67, No. 4, 1923, pp. 313, 314, (two figs. of hinge, p. 314).

Oedalina subdiaphana Carpenter, Lamy, *Journ. de Conchyl.*, Vol. 61, No. 3, 1914, p. 303, (two figs. of hinge, p. 302). California.

Type Locality: San Diego, California

⁸⁸ *Cooperellopsis* Woodring, Carnegie Institution of Washington, Publ. 366, May 25, 1925, p. 165. "Type.—*Cooperella (Cooperellopsis) thaumastra*, new species." P. 165, pl. 22, figs. 13, 14, 15. Bowden, Jamaica, Miocene.

(cited by Carpenter, 1865, and here designated as type locality). Region between San Diego and San Pedro, California, also Santa Barbara Islands, cited originally.

Range: Queen Charlotte Islands, British Columbia, to San Felipe, east coast of Lower California in the Gulf of California.

Collecting Station: Mexico: Santa Inez Bay, Gulf of California (145-D-1-3), 4-13 fathoms, sand.

Description: Shell small and fragile, nearly equilateral, moderately inflated, smooth or concentrically striated; hinge typical for the genus; margins smooth; pallial sinus deep and rounded at the end.

Specimens in the present collection are about 4-6 mm. in length. A large specimen from San Diego, California, in the collections of the California Academy of Sciences, measures: length, 14.6 mm.; height, 11.6 mm.; convexity (both valves), 7.3 mm.

Dall⁸⁹, 1903, gave a careful description of this species. He stated that the types of Carpenter's species "*Oedalia* subdiaphana and *Cooperella scintillaeformis* are in the United States National Museum. He considered them to represent the same species⁹⁰.

Haas⁹¹ described the "nest" which this species sometimes builds.

Cooperella atlantica Rehder⁹², recently described from Florida, is said to be smaller, more translucent and more equilateral than *C. subdiaphana*. *Cooperella carpenteri* Dall, 1903, described from the Miocene of Florida, is another similar species.

Distribution: Three small somewhat worn single valves of this species were dredged by the expedition in Santa Inez Bay in the Gulf of California, in 4-13 fathoms. It also has been recorded as occurring in the Pleistocene of San Pedro, Playa del Rey and San Diego, southern California, and at San Quintin, Lower California.

⁸⁹ Dall, W. H., *Trans. Wagner Free Inst. Sci.*, Vol. 3, Pt. 5, December, 1900, p. 1062.

⁹⁰ Orcutt, 1919, credited Dall for the identification, and cited *Cooperella scintillaeformis* as occurring at Magdalena Bay, Lower California (*West Amer. Sci.*, Vol. 21, No. 5 (169), 1919, p. 39).

⁹¹ Haas, F., *Nautilus*, Vol. 55, No. 4, 1942, p. 113.—Haas, *Field Mus. Nat. Hist., Zool. Ser.*, Vol. 29, No. 1, 1943, p. 12 fig. 7 (a, b). Alamitos Bay, San Pedro, California.

⁹² *Cooperella atlantica* Rehder, *Proc. U. S. Nat. Mus.*, Vol. 93, No. 3161, January 20, 1943, p. 187, pl. 19, figs. 3, 4. "dredged off Peanut Island, northern Lake Worth, Fla."

EXPLANATION OF THE PLATES.

PLATE I.

FIG. 1. *Pitar (Lamelliconcha) frizzelli* Hertlein & Strong, sp. nov. Holotype, right valve, from Station 136-D-22, Lat. 23° 28' 30" N., Long. 109° 25' W., Arena Bank, Gulf of California, dredged in 45 fathoms (82 meters). Length, 46 mm., height, 33.5 mm. P. 176.

FIG. 2. *Chione (Chione) guatulcoensis* Hertlein & Strong, sp. nov. Holotype, left valve, from Station 195-D-9, Lat. 15° 44' 28" N., Long. 96° 07' 51" W., off Port Guatulco, Mexico, dredged in 7 fathoms (12.6 meters). Length, 11.2 mm., height, 9.4 mm. P. 182.

FIG. 3. *Pitar (Pitarella) mexicanus* Hertlein & Strong, sp. nov. Holotype, left valve, from Station 192-D-1, Lat. 16° 16' 30" N., Long. 98° 37' W., 4 miles southwest of Maldanado Point, Mexico, dredged in 26 fathoms (47 meters). Length, 42.3 mm., height, 33.3 mm. View of the interior. P. 171.

FIG. 4. *Chione (Chione) guatulcoensis* Hertlein & Strong, sp. nov. Holotype. View of the interior of the right valve of the specimen shown in Fig. 2.

FIG. 5. *Pitar (Lamelliconcha) frizzelli* Hertlein & Strong, sp. nov. Holotype. View of the exterior of the left valve of the specimen shown in Fig. 1.

FIG. 6. *Chione (Chione) guatulcoensis* Hertlein & Strong, sp. nov. Holotype. View of the exterior of the specimen shown in Fig. 2.

FIG. 7. *Pitar (Lamelliconcha) frizzelli* Hertlein & Strong, sp. nov. Holotype. View of the interior of the specimen shown in Fig. 5.

FIG. 8. *Pitar (Pitarella) mexicanus* Hertlein & Strong, sp. nov. Holotype. View of the exterior of the right valve of the specimen shown in Fig. 3.

FIG. 9. *Pitar (Hyphantosoma) aletes* Hertlein & Strong, sp. nov. Holotype, right valve, from Station 136-D-13, Lat. 23° 29' N., Long. 109° 24' W., Arena Bank, Gulf of California, in 45 fathoms (82 meters). Length, 53.8 mm., height, 46 mm. View of the interior. P. 172.

FIG. 10. *Chione (Chione) guatulcoensis* Hertlein & Strong, sp. nov. Holotype. View of the exterior of the specimen shown in Fig. 4.

FIG. 11. *Pitar (Hyphantosoma) aletes* Hertlein & Strong, sp. nov. Holotype. View of the interior of the left valve of the specimen shown in Fig. 9.

FIG. 12. *Pitar (Hyphantosoma) aletes* Hertlein & Strong, sp. nov. Holotype. View of the exterior of the specimen shown in Fig. 9.

FIG. 13. *Pitar (Hyphantosoma) aletes* Hertlein & Strong, sp. nov. Holotype. View of the exterior of the specimen shown in Fig. 11.

All the specimens illustrated on this plate are in the type collection of the Department of Paleontology of the California Academy of Sciences.

PLATE II.

FIG. 1. *Chione (Chione) guatulcoensis* Hertlein & Strong, sp. nov. Paratype, left valve, from Station 195-D-9, dredged in Lat. 15° 44' 28" N., Long. 96° 07' 51" W., Port Guatulco, Mexico, dredged in 7 fathoms (12.6 meters). Length, 14.6 mm., height, 11.1 mm. P. 182.

FIG. 2. *Antigona (Ventricola) isocardia* Verriill. Hypotype, left valve, from Gorgona Island, Colombia. Length, 63.5 mm., height, 57.3 mm. P. 178.

FIG. 3. *Antigona (Ventricola) isocardia* Verriill. Hypotype, left valve, from Station 136-D-26, dredged in Lat. 23° 27' N., Long. 109° 24' W., Arena Bank, Gulf of California, in 45 fathoms (82 meters). Length, 48.2 mm., height, 44.5 mm.

FIG. 4. *Petricola (Petricola) lucasana* Hertlein & Strong, sp. nov. Holotype, left valve, from Cape San Lucas, Lower California, Mexico. Length, 24.6 mm., height, 25 mm. P. 194.

FIG. 5. *Cyclinella kröyeri ulloana* Hertlein & Strong, subsp. nov. Holotype, left valve, from Station 143-D-4, Lat. 26° 55' N., Long. 111° 54' W., Santa Inez Bay, Lower California, in the Gulf of California, dredged in 25 fathoms (46 meters). Length, 75.5 mm., height, 76.5 mm. P. 179.

FIG. 6. *Cyclinella kröyeri ulloana* Hertlein & Strong, subsp. nov. Holotype. View of the interior of the specimen shown in Fig. 5.

FIG. 7. *Cyclinella kröyeri ulloana* Hertlein & Strong, subsp. nov. Paratype, left valve, from the same locality as the holotype shown in Fig. 5. Length, 65.3 mm., height, 63 mm.

FIG. 8. *Chione (Chione) guatulcoensis* Hertlein & Strong, sp. nov. Paratype. View of the interior of the right valve of the specimen shown in Fig. 1.

FIG. 9. *Petricola (Petricola) lucasana* Hertlein & Strong, sp. nov. Holotype. View of the interior of the right valve of the specimen shown in Fig. 4.

FIG. 10. *Tivela delessertii* Deshayes in Sowerby. Hypotype, left valve, from Santa Inez Bay, Lower California, in the Gulf of California, on beach. Length, 30.9 mm., height, 23.5 mm.

FIG. 11. *Pitar (Lamelliconcha) trizzelli* Hertlein & Strong, sp. nov. Holotype, right valve from Station 136-D-22, Lat. $23^{\circ} 28' 30''$ N., Long. $109^{\circ} 25'$ W., Arena Bank, Gulf of California, dredged in 45 fathoms (82 meters). Length, 46 mm., height, 33.5 mm. P. 176.

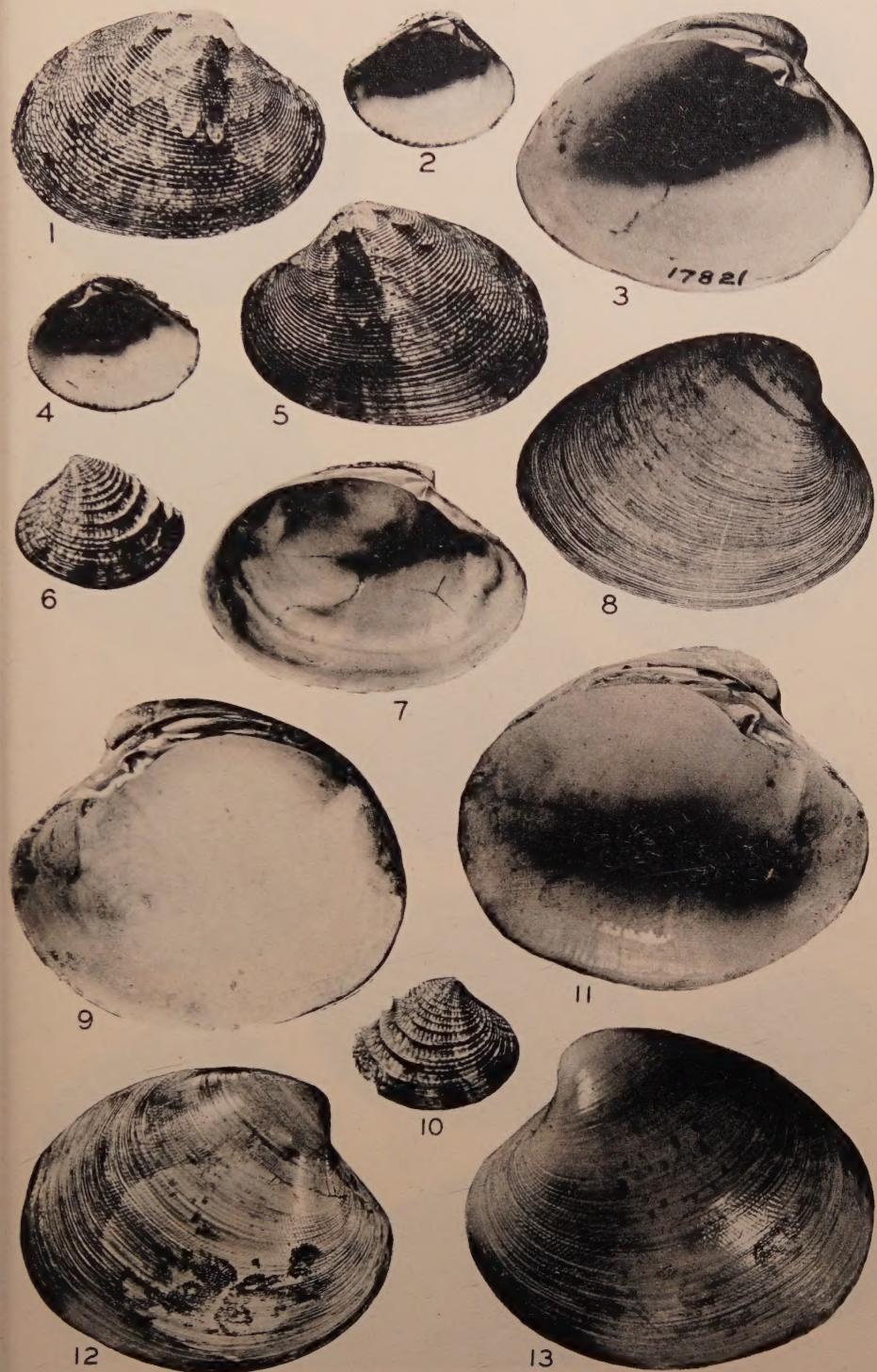
FIG. 12. *Chione (Chione) guatulcoensis* Hertlein & Strong, sp. nov. Paratype. View of the exterior of the specimen shown in Fig. 1.

FIG. 13. *Chione (Chione) guatulcoensis* Hertlein & Strong, sp. nov. Paratype. View of the interior of the specimen shown in Fig. 8.

FIG. 14. *Callocardia (Agriopoma) catharia* Dall. Hypotype, left valve, from Station 221-D-1-5, Lat. $7^{\circ} 54' 45''$ to $7^{\circ} 52' 30''$ N., Long. $82^{\circ} 04' 32''$ to $82^{\circ} 01'$ W., Gulf of Chiriqui, Panama, in 35-40 fathoms (64-73 meters). Length, 22.8 mm., height, 20.5 mm. View showing the hinge. P. 177.

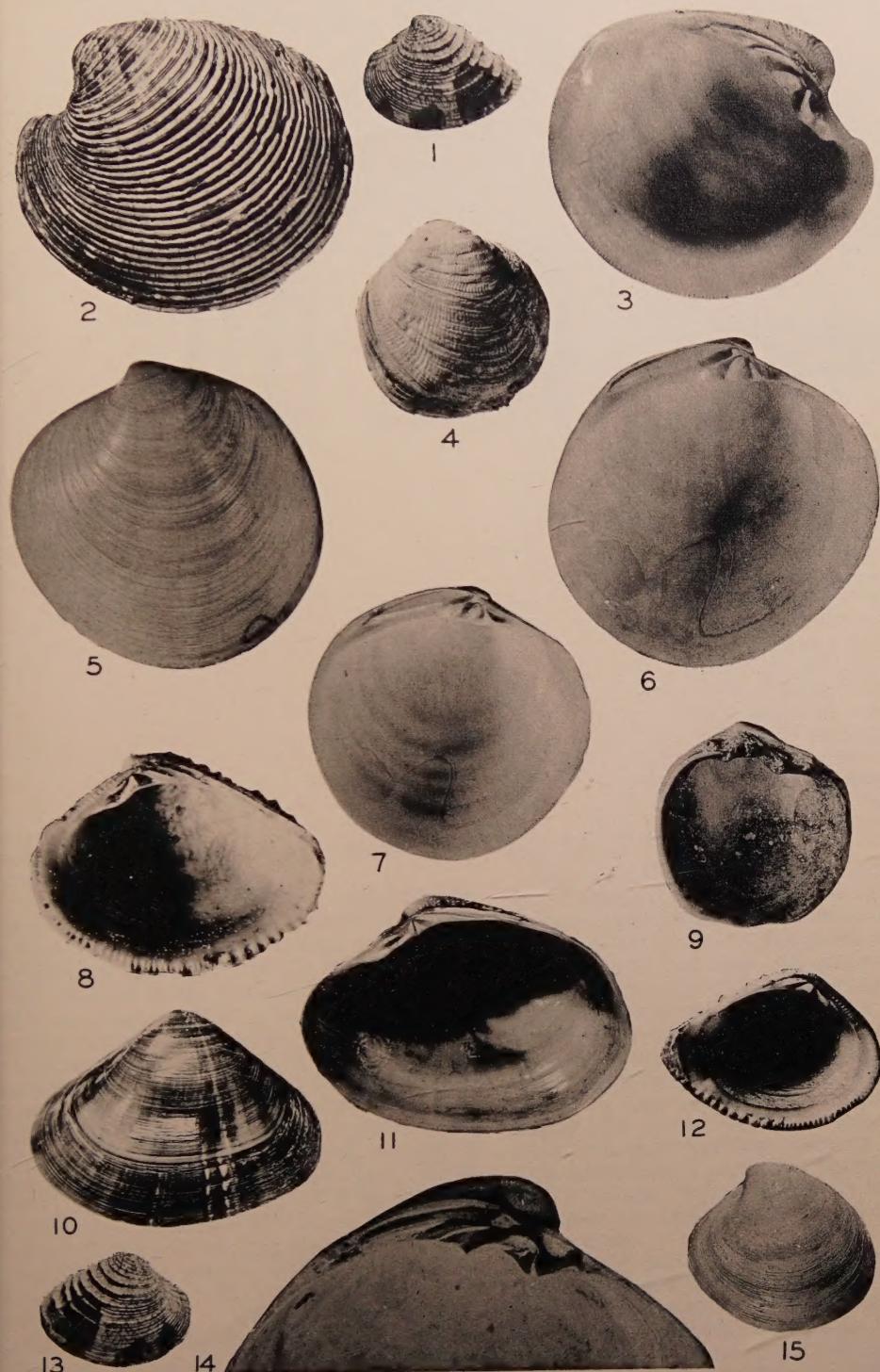
FIG. 15. *Callocardia (Agriopoma) catharia* Dall. View of the exterior of the specimen shown in Fig. 14.

All the specimens illustrated on this plate are in the type collection of the Department of Paleontology of the California Academy of Sciences.



MOLLUSKS FROM THE WEST COAST OF MEXICO AND CENTRAL AMERICA.





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